













# INDIAN SCIENCE CONGRESS ASSOCIATION

(REGISTERED UNDER ACT XXI OF 1860)

## PROCEEDINGS OF THE FORTY-FOURTH SESSION CALCUTTA-1957

### PART III ABSTRACTS



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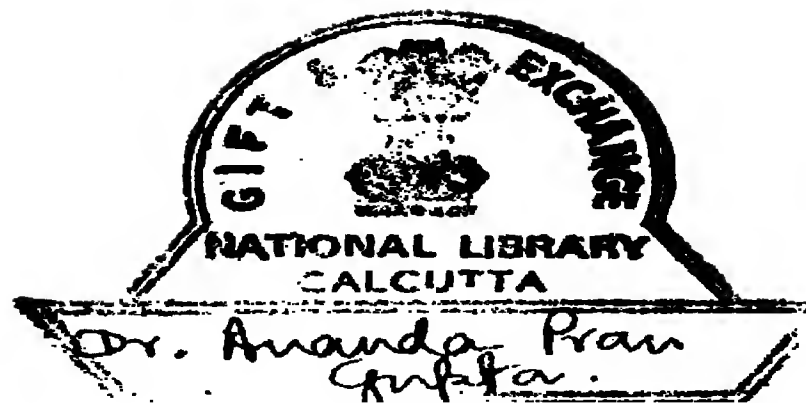


# PROCEEDINGS OF THE FORTY-FOURTH INDIAN SCIENCE CONGRESS

## PART III—ABSTRACTS

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# 44th INDIAN SCIENCE CONGRESS, CALCUTTA, 1957

## SECTION OF MATHEMATICS

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### *Abstracts*

1. The moment methods of summability defined by a class of completely monotone functions

S. K. BASU, Calcutta

The properties of a class of completely monotone function defined by

$$f(t) = \int_0^{\infty} e^{-tx} d\rho(x),$$

where  $\rho(x)$  is bounded, and  $\uparrow$  in  $[0, \infty)$ , and  $f^{(n)}(t)$  exists and is continuous for all  $n$  and  $t \geq 0$ , were discussed in a previous note (Science Abstract 1955). In the present paper we consider the moment methods of summability defined by the moment sequence where

$$\mu_n = (-1)^n f^{(n)}(0) = \int_0^{\infty} x^n d\rho(x) \quad (n = 0, 1, 2, \dots)$$

(For the moment method of summability see Hardy, Divergent Series, Oxford, 1949). Borel's integral method comes as a particular case of the moment methods considered here.

2. On the absolute Cesaro summability of a Fourier series

SHRI NIVAS BHATT, Allahabad

Let  $f(t)$  be integrable (L) over  $(-\pi, \pi)$  and periodic with period  $2\pi$ , and let its Fourier Series be

$$\frac{1}{2} a_0 + \sum (a_n \cos nt + b_n \sin nt)$$

$$= \frac{1}{2} A_0 + \sum A_n(t).$$

Writing

$$\varphi(t) = \frac{1}{2} \{f(x+t) + f(x-t)\}$$

the following theorem has been proved.

**Theorem.** If  $\varphi(t)$  is of bounded variation in the interval  $(0, \xi+\eta)$  and  $(\xi+\eta, \pi)$ ,  $\eta \rightarrow 0$ , and becomes infinitely great of the order  $\alpha$  ( $0 < \alpha < 1$ ) at the point  $t = \xi$ , such that

$$\varphi(t) = K |t - \xi|^{-\alpha},$$

then the Fourier series of  $f(t)$  is summable  $|c, \delta|$  for  $\delta > \alpha$  at the point  $t = \xi \neq \xi$ .

### 3. The absolute logarithmic summability of Fourier integral

R. MOHANTY and S. MOHAPATRA

1. We suppose throughout that  $f(t)$  is integrable  $L$  in  $(-\infty, \infty)$  and that Fourier integral of  $f(t)$  is

$$\int \psi(u) du \quad (1.1)$$

where 
$$\psi(u) = \int_0^{\infty} \phi(t) \cos ut \, dt$$

and 
$$\phi(t) = f(t+x) + f(t-x)$$

We write

$$I_n(\lambda) = \int \left( 1 - \frac{\log u}{\log \lambda} \right) \psi(u) du \quad (1.2)$$

$$\theta(t) = \int_t^{\infty} \frac{\phi(u)}{u} du \quad (1.3)$$

$$\phi_1(t) = \frac{\theta(t)}{\log t} \quad (1.4)$$

**Definition** :—The integral  $\int_0^{\infty} \psi(u) du$  is summable  $(R, \log \lambda, \alpha)$   $\alpha \geq 0$ , if  $I_n(\lambda)$  defined above exists as a Lebesgue integral for all  $\lambda \geq 0$  and tends to a limit as  $\lambda \rightarrow \infty$

The integral  $\int_0^{\infty} \psi(u) du$  is absolutely summable  $(R, \log \lambda, \alpha)$  or summable  $|R, \log \lambda, \alpha|$ ,  $\alpha \geq 0$  if  $I_n(\lambda)$  is of bounded variation in  $(e, \infty)$ , where 'e' is the Napierian base.

(Here we are concerned with the case  $\alpha > 1$ ). Differentiating formally under the sign of integration, we get for  $\alpha > 1$

$$\frac{dI_n(\lambda)}{d\lambda} = \alpha \int_0^{\lambda} \frac{\left( \log \frac{\lambda}{u} \right)^{\alpha-1} \log u}{\lambda (\log \lambda)^{\alpha+1}} \psi(u) du$$

Hence

$\psi(u)du$  is  $|R, \log \lambda, \alpha|$  if

$$I = \int_r \frac{d\lambda}{\lambda (\log \lambda)^{\alpha+1}} \left| \int_0 \left( \log \frac{\lambda}{u} \right)^{\alpha-1} \log u \psi(u) du \right| < \infty$$

We prove the following

*Theorem* :--If  $\phi_1(t)$  is of bounded variation in  $(0,2)$ , then (1.1) is summable  $|R, \log \lambda, 1+\delta|$  for every  $\delta > 0$ .

#### 4. On the multiplication of Dirichlet's series

B. N. PRASAD and T. PATI, Allahabad

Let us consider any two general Dirichlet's series (A)  $\sum a_n e^{-\lambda_n s}$  and (B)  $\sum b_n e^{-\mu_n s}$ , where  $s$  is complex. The formal product of these two series may be written as (C)  $\sum c_n e^{-\nu_n s}$ , where  $c_n = \sum_{\lambda_p + \mu_q = \nu_n} a_p b_q$ , and  $\{\nu_n\}$  is the ascending sequence formed

by all the values of  $\lambda_p + \mu_q$  ( $p = 1, 2, \dots; q = 1, 2, \dots$ ). If we associate Riesz summability of types  $\lambda$  and  $\mu$  with the series (A) and (B) respectively, we may associate Riesz summability of type  $\nu$  with the Dirichlet product (C).

In this paper we have studied the relationship of the abscissa of summability  $|\Re, \nu, k|$  of the series (C) with the abscissae of summability  $|R, \lambda, k|$  and absolute convergence of the series (A) and (B), respectively, and have established the following theorem.

*Theorem*. If  $k$  is a positive integer,  $\sum a_n e^{-\lambda_n s}$  is summable  $|R, \lambda, k|$  for  $s = s_1$  and  $\sum b_n e^{-\mu_n s}$  is absolutely convergent for  $s = s_2$ , where  $\Re s_2 > \Re s_1 \geq 0$ , then the Dirichlet product series  $\sum c_n e^{-\nu_n s}$  is summable  $|R, \nu, k|$  for  $\Re s = \Re s_2$ .

#### 5. On the convergence and summability of a series associated with the derived Fourier series

P. C. RATH and R. MOHANTY

Consider

$$\sum_{n=1}^{\infty} \frac{S_n(x)}{n} \quad (1)$$

where  $S_n(x)$  is the  $n$ -th partial sum of the series obtained by formally differentiating the Fourier Lebesgue series of a function  $f(x)$  integrable  $L(-\pi, \pi)$  and periodic with period  $2\pi$ . Writing

$$\psi(t) = f(x+t) - f(x-t), \quad g(t) = \frac{\psi(t)}{4 \sin \frac{1}{2}t}$$

and assuming that  $g(t)$  is  $L(-\pi, \pi)$  and defined outside  $(-\pi, \pi)$  by periodicity, we have the following,



**Theorem 1**

If

$$\lim_{\kappa \rightarrow \infty} \overline{\lim}_{\nu \rightarrow 0} \int_{\kappa \nu}^{\eta} \left| \frac{g(t+\nu)}{t+\nu} - \frac{g(t)}{t} \right| dt = 0 \quad (0 < \eta < \pi)$$

and

$$\int_0^{\pi} g(t) \operatorname{cosec} \frac{1}{2} t dt,$$

$\rightarrow 0$

exists as a Cauchy integral down to the origin, then the series (1) is convergent and

**Theorem 2,**If as  $t \rightarrow +0$ ,

$$\int_0^t |g(u)| du = O \left( t \log \frac{1}{t} \right),$$

$$G(t) = \int_t^{\pi} g(u) \operatorname{cosec} \frac{1}{2} u du = O \left( \log \frac{1}{t} \right)$$

and

$$\int_t^{\pi} \frac{G(u)}{u} du = O \left( \log \frac{1}{t} \right)$$

then the series (1) is summable  $(R, \log n, 1)$ .

**6. On the derivative of an entire function****S. M. SHAH and S. K. SINGH, Aligarh**

G. Valiron (*Fonctions Analytiques*, 1954) has proved that if  $f(z)$  be an entire function of order  $\rho$ , then

$$r M(r, f') < r^{\frac{1}{2}\rho + \varepsilon} \mu(r, f)$$

for all sufficiently large values of  $r$  exterior to a set of segments in which the total variation of  $\log r$  is finite. We show here that this is a best possible result. We also prove that for all  $r > r_0$ ,

$$\nu(r, f) \mu(r, f) < r M(r, f') < r^{2\rho + \varepsilon} \mu(r, f).$$

(For notations see S. M. Shah and S. K. Singh, *Proceedings Royal Society, Edinburgh*, Vol. LXIV, pp. 80-89.)

**7. On strong logarithmic summability of Fourier series****(KUMARI) PRAMILA SRIVASTAVA, Allahabad**

1. Let  $f(t)$  be a periodic function with period  $2\pi$  and integrable ( $L$ ) over  $(-\pi, \pi)$ . Let the Fourier series of  $f(t)$  be

$$f(t) \sim \frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt) = \Sigma A_n(t).$$

We write

$$\phi(t) = \frac{1}{2} \{ f(x+t) + f(x-t) - 2S \}.$$

2. If  $S_n$  denotes the  $n^{\text{th}}$  partial sum for a given series  $\sum_{n=1}^{\infty} c_n$ , then

$$\sum \frac{|S_n - S|^q}{n} = O(\log n),$$

as  $n \rightarrow \infty$ , defines strong logarithmic summability with index  $q$  to sum  $S$ , which is termed as summability  $[R, \log n, 1, q]$ . For  $q = 1$  summability  $[R, \log n, 1, q]$  is written as  $[R, \log n, 1]$ .

3. The first two theorems of this paper are :

Theorem 1. If

$$\int_t^1 |\varphi(u)| du = O(t),$$

and

$$\int_t^1 \frac{|\varphi(u)|^r}{u^r} du = O \left\{ \left( \frac{1}{t} \log \frac{1}{t} \right)^{r-1} \right\}, \quad r > 1,$$

as  $t \rightarrow 0$ , then  $\Sigma A_n(t)$  is summable  $[R, \log n, 1]$  at the point  $t = x$  to sum  $S$ .

Theorem 2. If

$$\int_t^1 \frac{|\varphi(u)|}{u} du = O \left\{ \left( \log \frac{1}{t} \right)^k \right\},$$

as  $t \rightarrow 0$ , then  $\Sigma A_n(t)$  is summable  $[R, \log n, 1, 2]$  at  $t = x$  to sum  $S$ .

In Theorem 3 a sufficient condition for summability  $[R, \log n, 1, k]$  of  $\Sigma A_n(t)$  is obtained. Finally, we establish :

Theorem 4. If

$$\int_t^1 \frac{|\varphi(u)|}{u} du = O \left\{ \left( \log \frac{1}{t} \right)^e \right\},$$

as  $t \rightarrow 0$ , for all positive  $e$ , then  $\Sigma A_n(t)$  is summable  $(R, \log n, \delta)$  for every  $\delta > 0$ , to sum  $S$ , at  $t = x$ .

## 8. On absolute logarithmic summability of Fourier series

(KUMARI) PRAMILA SRIVASTAVA, Allahabad

1. Let  $f(t)$  be a periodic function with period  $2\pi$  and integrable ( $L$ ) over  $(-\pi, \pi)$ , and let the Fourier series of  $f(t)$  be

$$\begin{aligned} f(t) &\sim \frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt) \\ &= \Sigma A_n(t). \end{aligned}$$

2. While investigating summability  $|R, \log n, \alpha|$  of a Fourier series, Sunouchi (Tohoku Math. Jour. 3 (1951), 114-122) proved a Tauberian lemma to the effect that if  $\sum c_n$  is summable  $|c, \beta|$  for some  $\beta$  and  $\int_0^N |dS_n^\alpha(x)| = O(\log N)$ , for some integral  $\alpha \geq 2$ ,

where  $S_n^\alpha(x)$  denotes the  $(R, n, \alpha)$  mean of  $\sum c_n$ , then the series  $\sum c_n$  is summable  $|R, \log n, \alpha|$ . In his review of the paper Bosanquet remarks that the lemma could probably be replaced by the more general result that if  $\sum c_n$  is summable  $|c|$  and  $(\log x)^{-\alpha} S_n^\alpha(x) = O(1)|c, 0|$ , then  $\sum c_n$  is summable  $|R, \log n, \alpha|$ . It may be observed that the latter result holds also for  $\alpha = 1$ ; but in this case the form under consideration is not more general than that given by Sunouchi. However, in case of Fourier series we prove the following theorem for  $\alpha = 1$ .

**Theorem.** *If  $f(x) \in L^r$ ,  $r > 1$ , the series  $\sum A_n(t)$  is summable  $|R, \log n, 1|$  for almost all values  $x$  of  $t$  for which it is summable  $|c|$ .*

## 9. On the Cesàro non-summability of Fourier series

(KUMARI) SULAXANA KUMARI, Allahabad

Regarding the non-summability  $(c, 1)$  of a Fourier series of a Lebesgue integrable periodic function  $f(\theta)$ , at  $\theta = x$ , examples have been framed by Hahn (Jber Deutsch. Math. Ver., 25 (1916), 359-366), Prasad (Math. Z., 40 (1935), 496-502), Misra (Bull. American Math. Soc. (1947), 501-514) and Sinvhal (Ganita, 1 (1950), 27-30), with the increasing degree of generality. Filling completely the gap existing between the summability and the non-summability of a Fourier series, the following theorem has been proved in this paper, by means of an example.

**Theorem 1.** *The conditions*

$$(i) \quad \eta(t) = \int_0^t \frac{\varphi(u)}{u} du = O \left\{ 1 / \log \left( \frac{1}{t} \right) \right\}, \quad \text{as } t \rightarrow 0,$$

where  $\varphi(t) = \frac{1}{2} \{ f(x+t) + f(x-t) - 2s \}$ , and

$$(ii) \quad \int_0^t \eta(t) dt = O \left( t / \log \left( \frac{1}{t} \right) \right), \quad \text{as } t \rightarrow 0.$$

are not sufficient for the summability  $(c, 1)$  of the Fourier series of  $f(\theta)$ , at  $\theta = x$ .

In Theorem 2, the above result is generalized to the case of non-summability  $(c, \alpha)$ , for any  $\alpha > 0$ , for the Fourier series of  $f(\theta)$ , at  $\theta = x$ .

## 10. Determination of the jump of a function by means of its Fourier series

(KUMARI) SULAXANA KUMARI, Allahabad

1. Let the series conjugate to the Fourier series of a Lebesgue integrable periodic function  $f(\theta)$  be

$$\sum_{n=1}^{\infty} (b_n \cos n\theta - a_n \sin n\theta) = \sum_{n=1}^{\infty} B_n(\theta).$$

Writing

$$\psi(t) = \frac{1}{2} \{ f(x+t) + f(x-t) \}, \quad \theta(t) = \psi(t) - \rho,$$

$$\theta_\alpha(t) = \frac{\alpha}{t^\alpha} \int_0^t (t-u)^{\alpha-1} \theta(u) du, \quad \alpha > 0,$$

suppose that  $\tau_k(w)$  denotes the  $(R, w, k)$  mean of the sequence  $\{n, B_n(\theta)\}$ , at  $\theta = x$ .

2. In this paper the following results have been established regarding the behaviour of the Cesàro means of the sequence  $\{n B_n(x)\}$ .

(i) If for  $\alpha > 0, -1 < \rho < 1, \alpha + \rho > 0,$

$$\int_0^t |\theta_\alpha(u)| du = O \left( t^{\rho+1} / \left| \log \frac{1}{t} \right| \right), \quad \text{as } t \rightarrow 0,$$

then we have

$$\tau_{\alpha, \rho+1}(w) - \frac{2\rho}{\pi} = O(w^{-\rho}), \quad \text{as } w \rightarrow \infty.$$

(ii) If for  $\alpha > 0, -1 < \rho < 1, \alpha + \rho > 0, \rho > -1,$

$$\int_0^t \frac{|\theta_\alpha(u)|}{u} du = O \left\{ t^\rho \left( \log \frac{1}{t} \right)^{\rho+1} \right\}, \quad \text{as } t \rightarrow 0$$

then we have

$$\tau_{\alpha, \rho+1}(w) - \frac{2\rho}{\pi} = O \left\{ w^{-\rho} (\log w)^{\rho+1} \right\}, \quad \text{as } w \rightarrow \infty.$$

(iii) If for  $1 > \rho > 0, 0 < \beta \leq 2(\rho+1),$

$$\int_0^t |\theta_\beta(u)| du = O(t^{\rho+1}), \quad \text{as } t \rightarrow 0,$$

then we have, for

$$\alpha \geq \rho / (\rho+1),$$

$$\tau_{\alpha+1}(w) - \frac{2\rho}{\pi} = O(1), \quad \text{as } w \rightarrow \infty$$

(iv) If for  $\beta > 2(\rho+1), 1 > \rho > 0,$

$$\int_0^t |\theta_\beta(u)| du = O(t^{\rho+1}), \quad \text{as } t \rightarrow 0$$

then we have, for  $\alpha \geq \beta - (1 + \{\beta\}) \rho / (1 + \rho)$ , where  $\{\beta\}$  denotes the fractional part of  $\beta$ ,

$$\tau_{\alpha+1}(w) - \frac{2\rho}{\pi} = O(1), \quad \text{as } w \rightarrow \infty.$$

3. Analogous results regarding the behaviour of the Cesàro means of the Conjugate series  $\Sigma B_n(x)$  have been also deduced from the above theorems.

## 11. Studies in contact transformation over a complex space

N. N. GHOSH, Calcutta

The paper is concerned with a new treatment of contact transformation regarded as a special transformation in a complex space which leaves the components of an elementary complex tensor invariant. Many of the known properties of contact transformations then follow by applying the methods of 'Complex Tensor Calculus' developed earlier by the author. Introduction of a metric, metrical affinities, etc., in the complex space is a new feature with respect to a contact transformation.

## 12. Orthogonal tetrahedron

SAHIB RAM MANDAN, Kharagpur

An Orthogonal tetrahedron is one whose altitudes concur at its orthocentre where also concur its bi-altitudes and that the pairs of its opposite edges are orthogonal. One of the three conditions stated implies the other two. The aim of this paper is to assume the concurrency of its bi-altitudes and thence deduce the other two. Keeping this aim in view the problem is reduced to one on conics in a plane when we translate the perpendicularity of any two elements in space to the conjugacy of their traces in the plane at infinity w.r.t. the circle or an absolute conic there. The treatment is analytic and leads to interesting algebraic identities.

## 13. Spheres associated with a semi-orthocentric tetrahedron

SAHIB RAM MANDAN, Kharagpur

Prof. N. A. Court, in his paper on 'The Semi-orthocentric Tetrahedron', has introduced two types of spheres associated with such a tetrahedron. The aim of this paper is to introduce two more types and explain the mutual relations of the four types of spheres, thus arrived at, together with the circum-sphere of the tetrahedron leading to the following Theorem :

"The first Twelve-point Sphere and the Polar Sphere of an Orthogonal Tetrahedron are the two spheres of anti-similitude of its second Twelve-point Sphere and circum-sphere, whereas their sphere of similitude is the one having the join of the centroid and the orthocentre of the Tetrahedron as diameter. The five spheres just enunciated, are coaxial having the polar plane of the centroid w.r.t. the polar sphere, or of the Ortho-centre w.r.t. the tetrahedron, as their radial plane."

## 14. Stresses in a rotating circular disk of aeolotropic material considered as a three-dimensional problem

B. B. CHATTERJEE, Calcutta

This paper is concerned with the determination of stresses in a rotating circular disk having transverse isotropy, the problem being considered to be a three-dimensional one. As the problem is a three-dimensional one, cylindrical coordinates have been used.

15. Stress concentrations around a small inclusion on the axis of a circular cylinder under torsion

P. P. CHATTERJI, Calcutta

Stresses are calculated for the case of a small rigid inclusion (i.e., zero displacement on the surface of the inclusion) bonded to a large circular cylindrical shaft in torsion, the axis of the inclusion coinciding with that of the cylinder. The inclusions considered are of the shapes—(i) two spheres not touching each other; (ii) two spheres touching each other; (iii) inverse of an ovary ellipsoid with respect to its centre. By using curvilinear co-ordinates an exact solution of the problem has been obtained from the differential equation for the angle of rotation. The angle of rotation has been obtained in the form of convergent series in cases (i) and (iii) and in the form of a convergent integral in case (ii), from which stresses are derived. The results deduced involve Legendre's associated functions of the first and second kind, and Bessel functions of which the values can be easily obtained from the tables.

16. The  $\alpha$ -Lyrae-cluster

P. C. CHAUDHURI, Rajasthan

The present investigation was undertaken with a view to ascertain whether the stars of Rasmuson's list do exhibit any characteristic of the cluster motion on the basis of the well-known criteria such as position angles of the proper motion vectors, parallaxes, Hertzsprung-Russell diagram and radial velocities. The method consists in obtaining the convergent point of the cluster from the available proper-motion data of these stars given in the Boss's General Catalogue (1937), after applying correction due to Wilson-Raymond by use of Bohlin's equation. The convergent point was then used for the computation of the position angles of the total proper motions for all stars. Then the space velocity was derived from the spectroscopic parallaxes and proper motions. With this space velocity the parallaxes were computed and the radial velocity for each star was also computed. From the computed parallaxes absolute magnitude of an individual star was derived and the Hertzsprung-Russell diagram was drawn. On the basis of all these criteria it is found that the stars under examination do not exhibit any characteristic of a cluster motion.

17. Stress concentration around a small inclusion formed by the revolution of a cardioid about its axis on the axis of a circular cylinder under torsion

S. B. DUTT, Calcutta

Stresses have been calculated in the neighbourhood of a small rigid inclusion (signifying zero displacement on the surface of the inclusion) formed by the revolution of a cardioid about its axis and embedded in the mass of a large twisted circular cylindrical shaft, the axis of the inclusion coinciding with that of the cylinder.

18. On the advancement of a compressible fluid over an infinite plate with heat transfer

A. S. GUPTA, Kharagpur

In this paper, the advancement of a compressible fluid over a fixed flat plate at a zero angle of incidence is presented. The front of the fluid has been assumed to advance with a constant velocity and heat transfer has been taken into account. Analysis of the boundary layer equation shows that temperature decreases in the boundary layer from the leading edge when the plate is maintained at a constant temperature and the free stream velocity is assumed constant. The expressions for velocity and temperature have been obtained for various values of the Prandtl number.

19. Growth of boundary layer on a rotating sphere in certain non-Newtonian liquids

M. K. JAIN, Kharagpur

The growth of boundary layer on a rotating sphere in certain non-Newtonian liquids has been investigated by considering the Rheological equation

$$t_{ij} = -p\delta_{ij} + 2\mu d_{ij} + 4\mu_c d_{ik}^i d_{jk}^i$$

$$2d_{ij}^i = u_{,j}^i + u_{,i}^j$$

where  $t_{ij}^i$  is the stress tensor,  $d_{ij}^i$  is the flow tensor and  $u^i$  is the velocity vector. The constants  $\mu$  and  $\mu_c$  are coefficients of viscosity and cross-viscosity respectively.

It is found that there is an inflow in the equatorial plane and out-flow at the poles. In Newtonian liquid, there is an inflow at the poles and out-flow near the equator.

20. A mixed boundary value problem of elasticity with parabolic boundary

GUNADHAR PARIA, Kharagpur

The problem of finding the two-dimensional stress distribution in an elastic body having the parabolic boundary, under the mixed boundary conditions, has been reduced to the solution of the non-homogeneous Hilbert problem, following the method of complex variables. The result has been compared with that for a straight boundary, and it is seen that the boundary stresses increase as the curvature increases.

21. Study of the curving of the free jet

AJIT KUMAR ROY, Bangalore

The problem has been conceived of from an analogy drawn with the case of a diffuser, where due to the sudden widening of the tube (boundary), regions of high pressure (i.e., dead water regions) are developed along the boundary. In the present problem, the analogy with the diffuser is maintained excepting that a part of the stream in the jet deviates from the main stream in the region of high pressure (stagnation

pressure compared with the pressure rise in the dead water region in the diffuser problem) and proceeds back. This gives rise to the idea of the curving of the free jet. The problem has been studied by determining the form of the free stream line, breadth of the jet, curvature of the spiral into which the free stream line winds up, by the application of the momentum theorem, continuity equation, conformal transformation, etc.

## 22. New solutions for finite deformation

B. R. SETH, Kharagpur

In recent years the theory of finite deformation has received fresh impetus from a number of exact solutions that have been obtained for incompressible elastic bodies without assuming any form of the strain energy function. The exact solutions obtained for compressible bodies have not been very large, and in general they have been of the form obtained by the author. Extensive references to existing literature on the subject are given in the Presidential Address to the Section of Mathematics at the 42nd session of the Indian Science Congress\*.

Very few attempts have been made to obtain solutions for the finite bending of plates into shells. For a rectangular plate bent into a right cylindrical shell, the earliest exact solution on the basis of a linear stress strain tensor law was obtained by Seth. In the present paper an attempt has been made to discuss solutions which may be used to discuss the finite bending of plates into spherical shells. A linear stress strain tensor law is again assumed, and this gives sufficiently good results for technical applications.

• In cylindrical coordinates it is found that, if we take  $u = r - \varphi(r, Z)$ ,  $v = \theta(1 - A)$ ,  $w = Z - f(r^2 + Z^2)$ , all the equations of finite deformation and boundary conditions on a spherical shell can be satisfied only if

$$\varphi(r, Z) = \alpha r, f(r^2 + Z^2) = \beta(r^2 + Z^2)^{\frac{1}{2}(1-c)}$$

where  $\alpha$ ,  $A$ ,  $\beta$  are known constants and  $c = 2\mu/(\lambda + 2\mu)$ ,  $\mu$  and  $\lambda$  being elastic constants.

\*Seth, B. R., Non-linear continuum mechanics, Proc. Ind. Sci. Congress, Part II, (1955).

## 23. Note on the stresses produced by an impulsive radial displacement and by an impulsive twist applied to the inner surface of a spherical cavity in an infinite elastic medium

GHASI RAM VERMA, Rajasthan

In this paper the displacement and stress produced in an infinite elastic solid by a certain impulsive radial displacement and by an impulsive twist applied to the inner surface of a spherical cavity have been determined by the use of Dirac's  $\delta$ -function.

## 24. On the "partition function" of a time dependent assembly.

RANAJIT SEN GUPTA, Kharagpur.

Statistical mechanical methods are commonly used to study the systems in equilibrium only. For non-equilibrium systems methods of kinetic theory based on Boltzman integrodifferential equations are used. However every worker in the field



of transport phenomena knows how difficult it is to get from Boltzman equation physically verifiable results, especially when the intermolecular interactions are not of the simplest type. In the present paper we have developed the expression of the partition function for time dependent assemblies, directly from Liouville theorem. The final result is

$$\text{Partition function } z = \frac{1}{N!} \int \dots \int e^{-\frac{\Phi - \Psi - B}{kT}} \prod_{i=1}^N d\vec{X}^{(i)} e^{\frac{B}{kT}(t, \vec{X}^{(i)})} \\ = Q(t, T) e^{\frac{B(t, \vec{X}^i, T)}{kT}} \quad \dots (1)$$

where  $Q(t, T)$ , which is a function of temperature and time and  $B(t, \vec{X}^i, T)$  a function containing spatial coordinates as well. The different quantities appearing in equation (1) have the following meanings:—

$\Phi$  = intermolecular potential energy

$\int \Psi dt$  = External force function causing the system to conditions of mequilibrium and

$$B(t, \vec{X}^{(i)}, T) = -\frac{1}{kT} \Psi + \frac{1}{kT} \int_0^t \frac{\partial \Psi}{\partial \vec{\gamma}^N} dt - \frac{1}{(kT)^2} \int_0^t \int \frac{\partial^2 \Psi}{\partial \vec{\gamma}^N} dt^2 \\ + \frac{1}{(kT)^3} \int \int \frac{\partial^3 \Psi}{\partial \vec{\gamma}^N} dt^3 + \dots$$

$$\partial \vec{\gamma}^N \text{ being defined as } \sum_{i=1}^N \frac{\partial \vec{X}^i}{\partial \xi^i}$$

where  $\vec{X}^{(i)}$  and  $\xi^{(i)}$  are as usual spatial and velocity coordinates.

Expression (1) may be evaluated by modifying the wellknown methods of Ursell, Mayer and others and the derivation of this equation therefore extends the scope of partition function method of statistical mechanics to non-equilibrium assemblies as well.

## 25. The origins of geometry

U. C. BARDHAN, Calcutta

In the Vedas, Puranas and other works geometry can be traced; also in the works of early Indian mathematicians and astronomers, and in the Sulvasutras. Aryabhatta I and II, Barahamihir, Brahmas Gupta, and others seem to have written on geometry.

26. Value of  $\pi$  obtained and calculated by ancient Indians

U. C. BARDHAN, Calcutta

*Synopsis*

Early values—Sulva Sutras (C.500 B.C.)

The earliest record is obtained from Sulvasutras (C.500 B.C.). Period 500 A.D.—1200 A.D. From the early parts of the Christian era, Indian astronomers and mathematicians made original contributions and obtained a better approximation to the value of  $\pi$ . Different mathematicians obtained different values such as  $\sqrt{10}$ ,  $22/7$ ,  $3927/1250$ ,  $21600/6876$ . Aryabhatta the elder (born 476 A.D.) obtained the value of  $\pi = \frac{3927}{1250}$  (3.1416) --  $62,832/20,000$ . Brahmagupta (628 A.D.) adopted the value of  $\pi = \sqrt{10}$  ( $\approx 3.16227$ ) in his book *Brahma-Sphuta-Siddhanta*. This value  $\sqrt{10}$  is found in all Siddhantas specially in *Surja-Siddhanta* (the old and modern).

An explanation of the origin of the value of  $\sqrt{10}$ . Value of  $\pi = 22/7$  ( $\approx 3.14285\dots$ ) which is found for the first time expressly stated in India in the work of Aryabhatta—the younger (C. 950 A.D.). It is then found in Bhaskara's *Litavati* (1150 A.D.).

Origin of the value of  $\pi$  --  $21600/6876$  ( $\approx 3.14136\dots$ ).Dimensions of the earth and value of  $\pi$  deduced therefrom.

Indian mathematicians and astronomers have been charged with inconsistency by Burgess and Whitney, Kaye and Smith. Indian mathematicians and astronomers have been very unjustly criticised in this matter by foreign mathematicians and scholars but on closer examination it becomes evident that the inconsistency is more apparent than real. Dimension of the earth according to Aryabhatta. So-called Greek influence in Aryabhatta's value of  $\pi$  answered. Burgess believed that Indian Astronomy and Mathematics developed independently. It can be safely proved that Aryabhatta did not get inspiration from any foreigner for obtaining the value of  $\pi$ .

*Date of Aryabhatta's value of  $\pi$ .*

In later years Indians gave more accurate values of  $\pi$  some of which are correct up to 8th or 10th places of decimals.

*Values in Series*

The Indians also made interesting researches and obtained the values of  $\pi$  in series. There are interesting results for the values of  $\pi$  in series in *Tantra-Samgraha*, *Karana-Paddhati* and *Sadratna-mala*.

## SECTION OF STATISTICS

PRESIDENT : DR. P. K. BOSE M.Sc., D.Phil.

### *Abstract*

### Theoretical

1. The Distribution of a Linear Function of  $\chi^2$ -variates and allied non-central  $\chi^2$ -variates

B. R. BHAT, Dhawar

Box, G.E.P. (A.M.S. Vol. 25, p. 290) has obtained the distribution of a linear function of  $\chi^2$ -variates with even degrees of freedom by the method of partial fractions. In this paper the distribution is derived by the method of characteristic functions, the result being modified to include  $\chi^2$ -variates with odd degrees of freedom also. By the same method the distribution of a linear function of non-central  $\chi^2$ -variates is also derived.

2. Comparison of the means of  $K$  normal populations with unknown variances

P. K. BHATTACHARYYA, Calcutta

$\pi_1, \pi_2, \dots, \pi_k$  are  $K$  normal populations,  $\pi_j$  having mean  $\mu + \theta_j \sigma_j$  and variance  $\sigma_j^2$ .  $\mu$  is known and all other parameters are unknown; a positive quantity  $\delta$  is given. To decide for each  $\theta_j$  whether  $\theta_j > \delta$  or  $|\theta_j| < \delta$  or  $\theta_j \leq -\delta$  from samples of fixed sizes  $n_1, \dots, n_k$  from  $\pi_1, \dots, \pi_k$  respectively. A minimax decision procedure has been obtained for simple loss functions which depends on symmetric intervals of  $t_1, \dots, t_k$  where  $t_j = \sqrt{n_j} (\bar{x}_j - \mu) / s_j$ ,  $\bar{x}_j$  and  $s_j^2$  being the  $j$ th sample mean and variance respectively.

3. A Theorem in the theory of Optimal designs

I. M. CHAKRAVARTI, Calcutta

With the usual linear set up  $E(y) = \tau A'$ , the necessary and sufficient condition that the best linear estimates of two mutually orthogonal estimable linear parametric functions are uncorrelated is that

$$(A'A)(A'A) = \mu A'A$$

i.e., that non-zero roots of  $A'A$  are all equal. A similar result with the necessary modifications holds also for more than one set of parameters.

## 4. Analysis of a particular type of non-orthogonal data

M. N. DAS, New Delhi

If in a two-way classification with more than one observation per cell,  $n_{ij}$  denotes the number of observations in the cell defined by the  $i$ th class of one of the factors, say,  $A$  and the  $j$ th class of the other factor  $B$ , then it is well known that the data can be analysed without actually solving the normal equations if  $\frac{n_{ij}}{n_{ij'}}$  remains the same for all  $i$ 's,  $j$  and  $j'$  denoting any two classes of the factor  $B$ . It has been shown in this paper that if  $(n_{ij} - n_{ij'})$  remains the same for all  $i$ 's,  $j$  and  $j'$  having the same meaning as above, then also the data can be analysed easily, since this type of data can be so manipulated as to make an algebraic solution of the normal equations possible.

## 5. On tests of randomness of points on a lattice

S. C. DAS, Cuttack

Tests of randomness for the distribution of 'black' points on a rectangular lattice of 'white' points are well known. P. V. Krishna Iyer (1949b) has shown that the number of joins between adjacent diseased plants or the number of joins between healthy and diseased plants adjacent to each other may be used as criterions for testing the randomness of the distribution of diseased plants in a rectangular plantation. One may also use the number of joins between adjacent healthy plants as another test criterion. In mathematical model, the plantation may be referred to as a lattice of points, with diseased plants as black and healthy plants as white points. In this paper we discuss a rectangular lattice of points each of which may be of two kinds, say black or white. Using a simple model of an alternative hypothesis, the relative efficiency of the above tests is examined. It is shown that efficiency depends on the value of  $p$ , the probability of a point being black on the null hypothesis.

## 6. A note on the structure of a certain Stochastic Model

S. C. DAS, Cuttack

Dandekar (1955) has considered a sequence of trials with the following property : if a trial results in a success, the next  $(m-1)$  trials are bound to result in failures. The probability of a success in any trial in which a success is possible is  $p$ , and that of a failure is  $q$ , where  $p+q=1$ . Dandekar proves by an ingenious argument that the probability of a success in any  $(m-1)$  consecutive trials where the process has been going on for a long time, is given by

$$P = \frac{(m-1)p}{1+(m-1)p}.$$

However, this statement of the result is not very clear.

Basu, (1955) identifies this model as a stochastic process and derives the result found by Dandekar in a slightly different form.

In this paper we identify this stochastic process, which at first sight is not Markovian, as a Markov Chain and deduce the results found by Basu and Dandekar by an elementary method. We further find out simple expressions for the mean recurrence time and its variance in connection with this problem.

## 7. Diffusion by continuous movements

H. C. GUPTA, Aligarh

When diffusion in one or more dimensions is governed by a finite transition probability matrix for the velocity, the infinitesimal transition equations can be easily solved by the use of Fourier and Laplace transforms. In this paper this method is outlined for one-dimensional diffusion and the case of two possible values of the velocity has been treated with one ramification, namely, when there is a continuous supply of the particles at the origin at a rate given in terms of a Bessel function. Expressions for the p.d.f. and the d.f. have been found, in the latter case by use of Operational Calculus. Lastly in 5 the relation of the telegraph equation with the diffusion equation is discussed and it is shown that the telegraph equation without leakage can arise even when there is emigration.

## 8. On properties of some linear combinations of ordered observations from samples drawn from Rectangular and Exponential Distributions

A. GHOSAL, JEALGORA

The part played by linear combinations of ordered values of a sample  $(x_1, \dots, x_n)$  where  $x_1 < x_2 < \dots < x_n$ , in estimating the parameters of rectangular distribution  $(p(x) = \frac{1}{\theta_2 - \theta_1}, \theta_1 \leq x \leq \theta_2)$  and exponential Distribution

$(p(x) = \frac{1}{\theta} e^{-\frac{x-a}{\theta}}, a \leq x < \infty)$  has been discussed in the paper. Distribution of  $w_r (= x_{n-r} - x_{r+1})$ , the quasirange of  $r$ th. order, have been derived for samples drawn both from the rectangular and exponential distributions, and the role of  $w_r$  in estimating scale parameters has been studied. A class of unbiased estimates for the location parameter ( $\theta_1$ ) of the rectangular distribution is given by  $m_r (= \frac{1}{2}(x_{r+1} + x_{n-r}))$ , defined as quasi-midrange,  $m_0$  giving the estimate with minimum variance. The estimation of the parameters of the exponential distribution with the help of other linear combinations of ordered observations has been studied.

## 9. On the distribution of sample mean from Rectangular population

A. GHOSAL, JEALGORA

The sample mean  $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$  can be taken as the mean of the ordered values

$(x'_1, \dots, x'_n)$  of the sample  $(x_1, x_2, \dots, x_n)$  i.e.,  $\frac{1}{n} \sum_{i=1}^n x'_i$ , where  $x'_1 < x'_2 < \dots < x'_n$ . From

the distributions of  $x'_i$ , and joint distributions of  $(x'_i, x'_j)$  where  $i < j$ ,  $(x'_i, x'_j, x'_k)$  where  $i < j < k$  etc., the first four moments of the distribution of  $\bar{x}$  have been derived. The

values of  $\beta_1$  and  $\beta_2$  ( $\beta_1 = 0$ ,  $\beta_2 = 3 - \frac{6}{5n}$ ) obtained therefrom suggests that the sample mean from the Rectangular population follows the distribution of Pearson's Type II (viz.,  $Y = Y_0(1 - \frac{x^2}{a^2})^m$ ,  $-a \leq x \leq a$ ), which rapidly tends to normality with the increase of the sample size ( $n$ ).

## 10. A Special Case of the Ratio Estimate

M. V. JAMBUNATHAN, Mysore

The ratio method of estimating the population total or the population average of a specified character is extensively used in economics, biometrics, anthropometry and various other fields. Latterly, it is being widely used in sample surveys on account of its simplicity as well as its greater efficiency relative to simple random sampling, particularly when ancillary information is available in one form or another.

The ratio  $R = \bar{Y}/\bar{X}$  in the population is estimated by  $R_n = \bar{y}/\bar{x}$  the ratio of the sample means of  $y$  and  $x$ . This estimate is biased, and to the first order of approximation, the magnitude of the bias is given by

$$B(R_n) = \frac{1}{n} R(V_1^2 - \rho V_1 V_2),$$

and the variance of the estimate is given by

$$V(R_n) = \frac{1}{n} R^2 (V_1^2 - 2\rho V_1 V_2 + V_2^2),$$

where  $V_1, V_2$  are the coefficients of variation of  $x, y$  respectively, and  $\rho$  the correlation between  $x$  and  $y$  in the population.

In several instances, the numerator of the ratio in the sample estimate has expected value zero, so that both  $Y$  and  $R$  are zero. The above expressions for bias and variance then assume indeterminate forms. Not only that, but what is more, the very derivation cannot be justified in such a situation because the results are obtained by expansion in a series which involves powers of  $\bar{X}, \bar{Y}$  in the denominator. This exceptional case is investigated in this paper leading to an interesting result of which the following is a verbal statement.

"In determining the variance (to a first degree of approximation) of a ratio estimate the numerator of which has expectation zero, the denominator may be treated as a non-stochastic variate equal to its population value."

The paper also shows how this result could be applied with considerable saving of algebraic work to derive the usual formulae for the variance of a ratio estimate. It is further shown that the variance of the estimate can be partitioned into two components, one of which is the residual variance from the regression line, and the other is the variance due to the deviation of the ratio line from the regression line. As a corollary to this follows the well known result that the regression estimate is always more precise than the ratio estimate except when the relation between  $y$  and  $x$  is a straight line through the origin, in which case both the estimates have equal precision.

## 11. Efficiency of Double Sampling for Stratification

M. V. JAMBUNATHAN, Mysore

The theory of the method of Double Sampling for Stratification was first given by Neyman (1938) who has also worked out the optimum allocation. He does not, however, give the limiting conditions for this method to be more efficient than simple random sampling, and just indicates that the actual numerical evaluation of the variances in the two cases is needed to decide which method to use.

In this paper, the formula for the efficiency of the design is derived in terms of the population parameters and the conditions for achieving efficiency have been stated in algebraic form as follows :

Assuming that the cost of a single measurement of  $y$  in the  $i$ -th stratum is  $c_i^2$  times the cost of a single measurement of  $x$ , the efficiency  $E$  is given by

$$\frac{1}{E} = \frac{V(ds)}{V(ran)} = \left[ \frac{\bar{\sigma}c}{\bar{\sigma}} + \frac{\eta}{\bar{c}} \right]^2$$

where  $\sigma^2$  is the variance of  $y$  in the population,  $\bar{c}$  is the average cost of measuring  $y$ ,  $\bar{\sigma}_c$  is the weighted mean of the strata standard deviations, the weights being proportional to the product of  $c_i$  and the stratum size, and  $\eta$  is the correlation ratio of  $y$  on  $x$ . When the  $c_i$ 's are all equal to  $c$ , we get

$$\frac{1}{E} = \left[ \frac{\sigma}{\bar{\sigma}} + \frac{\eta}{c} \right]^2$$

where  $\bar{\sigma}$  is the weighted average of the stratum standard deviations, the weights being the strata sizes.

## 12. Approximation by a power of $\chi^2$

A. R. KAMAT and Y. S. SATHE, Poona

This paper is a continuation of our paper last year wherein we had reported our investigations about approximating the distribution of the mean square successive difference from a random normal sequence by a power of chi-square. The use of seeking this type of distribution has been discussed in that paper. In this paper we apply the same procedure to another estimate viz., the mean successive difference defined by

$$d = (n-1)^{-1} \sum_{i=1}^{n-1} |x_i - x_{i+1}|$$

In this case also it is found that the same power of chi-square may be used over a wide range of sample sizes. Hence test procedures corresponding to  $F$ -tests may be used to test the equality of two estimates of standard deviations based on  $d$ .

## 13. On a property of Fourier Transforms of finite probability distributions

R. G. LAHA, Calcutta

It has been shown that the Fourier transform of a proper finite probability distribution, (that is, the probability distribution contained in a finite interval) which is an integral function, can not be without zeros in the entire complex plane.

This property has been further utilised in proving that the random variable following a proper infinitely divisible (i.d.) law can not be bounded.

## 14. A note on Mitscherlich's Regression Law

V. N. MURTY, RAJAHMUNDY

W. L. Stevens and F. P. Gomes gave methods of fitting the Mitscherlich's Regression Law

$$y = a + \beta x^x$$

Both the methods involve considerable arithmetic labour. In this note an alternative method which is a combination of both the methods referred above is presented and simpler formulae for estimates of  $a$  and  $\beta$  are given.

## 15. On a Parametric relation between the parameters of a Balanced Incomplete Block Design

V. N. MURTY, RAJAHMUNDY

The following theorem is proved. In a Balanced Incomplete Block Design with Parameters,  $v, b, r, k, \lambda$ , if the H.C.F. of  $(b, r, \lambda) = 1$  then  $k(k-1)/\lambda$  is an integer. If the H.C.F. of  $(b, r, \lambda) > 1$  then there does exist designs which are not repetitions of a design, for which  $k(k-1)/\lambda$  is not a integer. The condition is also not sufficient.

## 16. The dual of a two associate PBIB design and derivation of a two parameter family of designs with two replications

C. S. RAMAKRISHNAN, Calcutta

In this paper, we discuss the analysis and structure of the dual of a two associate PBIB design. It is found that the overall analysis is simple, the expressions for standard errors of contrasts can be written down, but restrictions have to be imposed on the original PBIB design we start with, so that the dual has a small No. of varietal comparisons with different precisions.

By inverting the family of Group Divisible designs with  $v = mn$ ;  $k = 2$ ;  $\lambda_1 = 0$ ;  $\lambda_2 = 1$ , we derive a new class of two parameter family of designs with two replications, which turn out to be PBIB designs with five associate classes but which can be far more easily analysed by the dual method.

The parameters of the new family are

$$b = mn; \quad v = mn(m-1)n/2; \quad r = 2; \quad k = n(m-1);$$

$$\lambda_1 = 1, \quad n_1 = 2(n-1); \quad \lambda_2 = 1; \quad n_2 = 2(m-2)n; \quad \lambda_3 = 0;$$

$$n_3 = (n-1)^2; \quad \lambda_4 = 0; \quad n_4 = 2(n-1)m(m-2);$$

$$n_5 = (m-2)(m-3)n^2/2.$$

Easy ways of writing down the plan, determining the type of associate-ship and expressions for standard errors of varietal comparisons are also given.

By replacing each variety by a group of  $t$  varieties in the above class of designs, we derive a three parameter family of designs with two replications. The close relationship between these designs and the original, enable us to analyse them as easily as the original design.



## 17. Study of Space Correlations in a plane

S. N. SEN, Barrackpore

Considering the plane to be generated by a large number of line transects or parallel strips of non-appreciable thickness, observations are taken equidistantly from the ultimate cells in the strips. Thus in an agricultural field, the fertility trend of soil may depend on both the directions except in case of a strong slope. From such considerations, the space or intraclass correlations are calculated from the analysis of variance set up and also the empirical autocorrelations of different lags are worked out separately. The concordance between the space correlations and the auto-correlations upto a certain gap are noted which leads to the conclusion that the effects of higher order auto-correlations are either non-existing or cancelled out. The study was carried out over 16 blocks of square shape, in both horizontal and vertical directions and the concordance was noted in a major number of blocks. The autocorrelations are noted, in almost all the blocks, to be decreasing functions of gap.

In 6 blocks where the magnitude of autocorrelations, exhibited in horizontal and vertical strips, are small, the simplest realistic stationery model of the form:  $x_s = \rho x_{s-1} + \varepsilon_s$  seems to be a satisfactory fit in both the directions. The expected autocorrelations from the process:  $\rho_s = \rho_1^{|s|}$  and the observed autocorrelations from the empirical formula are not behaving differently.

Attempts have been made to represent the two-dimensional correlograms as sums of exponentials, and in 4 such blocks which satisfy the natural properties underlying such process, the correlation function of the type:  $\rho(1,1) = \rho(1,0)\rho(0,1)$  seems to be true.

The study is being continued for getting the appropriate models.

## 18. The efficiency of the "TWO-MOMENTS" estimate of the parameter in a singly truncated binomial distribution

G. P. PATIL, Calcutta

Fisher (1956) and Haldane (1932, 1938) discussed uses of the truncated binomial distribution. For instance, in problems of human genetics in estimating the proportion of albino children produced by couples capable of producing albinos, sampling has necessarily to be restricted to families having at least one albino child. Fisher suggested the use of the method of maximum likelihood method which, though "efficient", however, leads to a rather complicated equation.

For a slightly different problem, where, in a sample from a complete binomial distribution, the frequencies in some lowest classes are missing, Rider (1955) suggested a method of estimation, which uses first two moments of the complete binomial and leads to a linear equation.

In this paper, following Rider's technique, an estimate of the parameter of a singly truncated binomial distribution is obtained by equating the first two theoretical moments of the truncated distribution to the corresponding sample moments. This estimate turns out to be very simple to compute. The large sample standard error of this estimate is derived. Comparison with the maximum likelihood estimate in certain important cases shows that the loss of efficiency for this "two-moments" method of estimation is not serious.

## 19. On the Efficiency-factor of incomplete block designs

J. Roy, Calcutta

For an incomplete block design in which each block has  $k$  plots and each treatment occurs in at most one plot in each block and altogether in  $r$  blocks, the following bounds on the efficiency factor  $E$  have been derived :

$$1 - \frac{x_1}{rk} \leq E \leq 1 - \frac{x_2}{rk}$$

where  $x_1$  and  $x_2$  are respectively the largest and the smallest of all the latent roots other than  $rk$  of the association matrix  $\Lambda = ((\lambda_{jj}'))$  of the design where  $\lambda_{jj} = r$  and  $\lambda_{jj'} =$  number of blocks in which  $j$ th and  $j'$ th treatments occur together.

As a corollary it follows that the efficiency-factor  $E^*$  of a Linked Block design obtained by dualising a Balanced Incomplete Block design with efficiency-factor  $E$  satisfies the inequality

$$E \leq E^* \leq 1$$

## 20. On Configurational Association Schemes

P. M. Roy, Calcutta

Any scheme for showing mutual relationship of the varieties of an incomplete block design is said to be an Association Scheme. In this communication it has been shown that in some cases geometrical configuration can be fruitfully utilised for the purpose. As an example it has been shown that the design obtained by Bose and Nair (*Sankhya*, 1939, Vol. 4, p. 354) from Icosahedron has a configurational association scheme which can be stated as follows :

For a chosen variety other varieties are 1st, 2nd or 3rd associates according as they are at one unit, two units or three units' distance on the figure.

This also shows that the said design of Bose and Nair is not the PBIB design with two accuracies as mentioned by them, but is a PBIB design with three accuracies, the parameters being

$$v = 12, \quad b = 20, \quad r = 5, \quad k = 3,$$

$$\lambda_1 = 2, \quad \lambda_2 = \lambda_3 = 0, \quad n_1 = n_2 = 5, \quad n_3 = 1,$$

$$p^1 = \begin{pmatrix} 2 & 2 & 0 \\ 2 & 2 & 1 \\ 0 & 1 & 0 \end{pmatrix}, \quad p^2_{jj'} = \begin{pmatrix} 2 & 2 & 1 \\ 2 & 2 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \quad p^3_{jj'} = \begin{pmatrix} 0 & 5 & 0 \\ 5 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}.$$

## 21. Generalization of Product Formula

K. C. SEAL, Calcutta.

It is shown that there exists a class of estimating equations besides the product formula used in double backcross or single backcross families which leads to asymptotically efficient estimates. Among these estimating equations the product formula, however, has the special property that the corresponding estimating equation is expressible in a simple compact form,

## 22. On a Characterization of Gamma Variables

K. C. SEAL, CALCUTTA

It is shown that the stochastic independence of  $\sum_{i=1}^k x_i$

and  $\sum_{i=1}^k a_{ki} x_i \bigg/ \sum_{i=1}^n x_i, (a_{k1}, \dots, a_{kn}) \neq (\lambda, \dots, \lambda),$

where  $x_1, \dots, x_k$  ( $k > 2$ ) are  $k$  mutually independent positive and proper random variables with finite second moments does not imply that  $x_i$ 's are all gamma variables with the same scale parameter. However, if  $x_i, i=1, 2, \dots, n$ , are  $n$  mutually independent positive proper random variables such that  $\sum_{i=1}^k x_i$  and  $\sum_{i=1}^k a_{ki} x_i \bigg/ \sum_{i=1}^k x_i$  are stochastically independent for  $k=2, 3, \dots, n$ , then and then only the variables  $x_i, i=1, \dots, n$ , follow gamma distributions having the same scale parameter. This characterization does not hold even if independence of  $\sum_{i=1}^n x_i$  and  $\sum_{i=1}^k a_{ki} x_i \bigg/ \sum_{i=1}^k x_i, k \neq j$ , where  $j$  is an integer lying between 2 and  $n$ , is assumed.

## 23. The Power-Function of the Analysis of Variance F-test in a One way classification

K. SUNDARESAM, Teinpati

In this paper the distribution of observations in several groups are examined so as to minimise the Power-Function of analysis of variance test for differences between groups with regard to an alternative hypothesis specifying the relative variability between groups to within groups i.e.,  $\frac{S^2}{\sigma_0^2}$ .

By the method of Lagrange's multipliers it is proved in this paper that the Power-Function  $(\beta(v_1, v_2, \lambda))$  cannot be minimum when the number of groups  $k$  and the number of observations  $N$  are fixed unless the means form two sets the group means in each set being equal but different from the other set and half the number of observations are distributed among the groups belonging to the same set.

## Applied

## 24. Cycle of Rainfall in Twenty-Nine Districts of Uttar Pradesh

A. P. BHATTACHARYA, Roorkee

This paper, which is a comprehensive one based on this year's as well as past work, contains a resume of investigations carried out for detecting a cycle in the series of annual rainfall figures for twenty-nine districts of Uttar Pradesh. This was done primarily for the benefit of the irrigation engineer in view of the high correlation between annual rainfall and total irrigation, i.e., irrigation from all sources, particularly when the net cultivated area does not change significantly. The establishment of a well defined cycle in the series of annual rainfall figures would thus indi-

rectly give an idea as to whether a year was going to have abnormal, average or sub-normal total irrigation. Hence the study was likely to give some idea of the requirements of water for irrigation in a particular year.

Kendall's methods of studying Time Series were followed in the above investigations. In the case of fourteen districts, the series was found to be wholly random. For the remaining fifteen districts, a big random portion was noticeable. Eleven were generated by an autoregressive scheme and four by moving averages. A wide variation in the type of the series and the period was discernible. The latter was found to vary from 3.25 to 6.67 years. The above study was sponsored by the Irrigation Research Institute, Roorkee.

## 25. Analysis of Marks in the I.A.S. Examination, 1952 and 1953

S. B. CHAUDHURI and A. K. BHATTACHARJEE, Calcutta

An analysis of marks in the I.A.S. Examination in the years 1952 and 1953 has been made. Equivalent scores have been calculated in some important subjects with respect to a standard, namely British History which is taken up by a majority of students as one of the combination subjects. On the basis of the equivalent scores it is suspected that in addition to random fluctuations there are intrinsic differences among the different subjects, differences in aptitude of candidates in different subjects and also differences in standards of examination in different subjects. It is also noticed that the standard of examination has changed from 1952 to 1953.

Considering the top-ranking students in the usual method it was noticed that ranks were much changed by scaling with the help of equivalent scores. A study of discrimination between Bengali and Non-Bengali students was also made.

## 26. Analysis of Covariance of Incomplete Block Designs with or without Missing Values

M. N. DAS, New Delhi

A general method of intra-block analysis of covariance, suitable for all incomplete block designs with the two-way classification has been deduced following the method of fitting constants. Results in cases of incompleteness due to missing values in any design including randomised block, have also been obtained. It has been shown that in all the designs the analysis can be conducted as in ordinary orthogonal designs by using the adjusted S.S.'s and S.P.'s in the error and treatment lines. The adjusted sum of product in the treatment line is given by  $\sum t_i \theta_i(x)$  or  $\sum t_i(x) \theta_i$ , where  $t_i$  is the estimate of the  $i$ th treatment effect from the  $y$ -variate and  $\theta_i(x)$  is the adjusted total of the same treatment from the  $x$ -variate. The adjusted error S.P. can be obtained by subtracting the adjusted treatment S.P. from the within block S.P. ignoring treatment classification. Expression for finding the standard error of the difference between any two adjusted treatment effects has come to be for the general case:

$$\text{Var } (t_i' - t_m') = V + \frac{\{t_i(x) - t_m(x)\}^2}{\{a - \sum t_i(x) \theta_i(x)\}} \sigma^2$$

where  $t_i'$  and  $t_m'$  are the adjusted treatment effects and  $V$ , the variance of  $(t_i - t_m)$  using the adjusted error mean square,  $\sigma^2$  being the within block S.S. for the  $x$ -variate.

## 27. Some Aspects of Scaling in the two-stage selection process

B. DAS GUPTA, Calcutta

The most economical and efficient selection procedures are frequently Two-stage processes. In the first stage a large number of applicants can be screened by means of inexpensive group tests. The most promising of these candidates can then be called for individual testing and interview. If the scores of both the first stage and the second stage tests are to be added together to determine order of merit, it is desirable that both scales be equated. A method has been derived whereby the small group of individuals tested at the second stage can be given the standard scores which they would have received had all of the first stage applicants been administered the individual tests. The method involves the estimation of the mean and s.d. of the total group on the second stage tests, by means of the actual values on the restricted group, and the corrected intercorrelations between the two sets of tests.

## 28. Sampling Technique in the study of Tourism

M. K. GANGULI and PREM NARAIN, New Delhi

Under Indian conditions unstratified systematic sample from the lists of tourists coming to hotels run on western style offers the most convenient and practicable procedure in a tourist study. It has been found preferable to introduce stratification during the analysis rather than in the sample design stage. Absence of periodicity in the lists of tourists which have to form the sampling frame makes a systematic sample sufficiently representative of the tourist population. The investigation also proves that a systematic sample of the present case is as efficient and precise as a random one and possesses all the requisites for the classical theory of random observations to be followed.

## 29. Story of Sampling Experiment

A. R. KAMAT, Poona

When the probability distribution of a sample statistic cannot be obtained exactly usually some approximate distribution is suggested. Sometimes a sampling experiment is then undertaken in order to obtain empirical sampling distributions so that the adequacy of the suggested approximate distribution can be examined. In this paper an account is given of an extensive sampling experiment which was undertaken in order to get empirical sampling distributions of the mean successive difference from a random normal sequence. The sampling distributions for various sample sizes are obtained from Wold's random normal deviates with the help of the Hollerith punch-card equipment. Comparisons are given between the empirical sampling distributions so obtained and the approximate distributions suggested by the author in one of his previous papers. There is good agreement between the empirical distributions and the proposed approximate distributions.

## 30. Inter-relation between Fertility-patterns obtaining in different sections of population in West Bengal

A. C. NAG, Calcutta

In the present note five fertility tables have been prepared for married women—three for Bengal, one for Bombay and one for Madras. The tables extend over mothers

of two generations. The sources of data are (a) Sample Surveys in villages and towns, (b) Life Office Records and (c) Maternity Home records. Sample size is of the order of 10,000 children each. Tables have been prepared on actuarial basis, using exposed to Risk formula. The total fertility figure has varied from 5 to  $5\frac{1}{4}$ . A second degree parabola has been fitted in each case over the age-period 18-38 and the fitting has been good. As Nature is allowed to have undisturbed play in the field of reproduction in villages, the village curve has been considered as the "fundamental" curve of fertility. It has been shown that the distribution of the interval between successive births is not influenced by the age at marriage of the mother. So, the peak of the fertility curve is shifted to a higher age by late marriage. Again the fall in fertility rates from modal value has been steeper in towns and more so in better class town-dwellers, may be for family-planning. But modal fertility rates for all the samples may be derived from the fundamental curve. Further, it has been shown that age-difference of 5-14 years is optimum for reproduction purpose.

### 31. Regression Models in estimating Jute fibre from single plant and Bulk

S. N. SEN, Barrackpore

The search of suitable regression models for prediction of fibre of jute crop from both single plant and bulk is carried from the study of various easily measurable auxiliary characters. Thus to estimate fibre from the single plant at the pre-harvest stage, the regression model of the type  $y = a_0 x_1^{a_1} x_2^{a_2} x_3^{a_3}$  is found to be the closest fit, where  $y$  = expected yield of fibre,  $x_1$  = technical height of plant,  $x_2$  = basal diameter and  $x_3$  = scoop weight of the bark. For the different varieties under the two species, *C. Olitorius* and *C. Capsularis*, the above model can be used although the constant terms are different for different varieties. The exclusion of  $x_3$  from the above model is found to affect the efficiency of estimation. Various properties of the prediction equations for different varieties under different conditions are studied.

For estimating fibre contents from bulk or bundle of plants say, when these are kept for steeping on the field at the post-harvest stage, the auxiliary varieties viz., the mean height of bundle, the girth near the base and the number of plants in the bundle may be used. The regression model is found to be of the same type as in the case of single plant estimation.

After the tests of significance for the regression function and the goodness of fit, the above regression model is found to be suitable in both the cases of estimation at the pre-harvest and post-harvest stages respectively.

## SECTION OF PHYSICS

PRESIDENT : DR. K. R. DIXIT, Ph.D. (Lond), F.A.Sc. F.N.I.

### *Abstracts.*

#### I. Mechanics.

##### 1. Gravitational Field of distant rotating masses

R. V. WAGH, Poona

In 1918, Thirring calculated the gravitational field near the centre of a rotating spherical shell. The case can be generalised to that of a rotating mass, where the field away from the mass can be determined. Thirring assumed

$$T^{\mu\nu} = \rho v^{\mu} v^{\nu} \quad \dots (i)$$

But it can be shown that, starting from a Galilean field we can build up the case to a non-Galilean field by introducing some small term in the metric tensor whose Galilean value is unity. Then by a straight forward process, we calculate  $T^{\mu\nu}$  given by

$$T^{\mu\nu} = (\rho_0 + \rho_{00})v^{\mu} v^{\nu} - \rho_0 g^{\mu\nu} \quad \dots (ii)$$

By the introduction of a rotating mass in the Galilean field, which now slightly deviates from its original characteristics is given by the metric tensor

$$\left. \begin{aligned} g_{11}, g_{22}, g_{33} &= -(1+\alpha)(1, r^2, r^2 \sin^2 \theta) \\ \text{and } g_{44} &= (1-\alpha) \end{aligned} \right\} \quad \dots (iii)$$

The energy-momentum tensor is then calculated and it is shown that this satisfies the conditions of mechanics. It is incidentally shown that there is no necessity of

introducing  $E^{\mu\nu}$  in the expression for  $T^{\mu\nu}$ , as recently done by Bass and Pirani. The desired results are obtained without making such assumptions.

##### 2. Gravity interpretation by optical analogy—A suggestion

AMALENDU ROY, Kharagpur

Based on the fact that the intensity of illumination and the gravity field both fall off as inverse square of the distance from a point source, two optical methods are suggested which can experimentally interpret observed gravity maps in geophysical prospecting. In the first experiment, corresponding to the Indirect method of gravity interpretation, the mass distribution are to be simulated by photographic films that have been previously darkened by exposure in the inverse ratio of the thickness of the mass distribution at every point. Illuminated from below by an extended source

of light, this will produce light intensity on higher planes that will be proportional to the gravity effect of the given mass. In the second experiment, corresponding to the Direct method of gravity interpretation, point sources of light are adjusted till the intensity of illumination on a plane above becomes proportional at every point to the observed gravity field. The intensity on any lower plane will, in that case, correspond to a mass distribution that could cause the observed gravity.

## II. Thermal Conduction etc.

### 3. Thermal Conductivity of Binary and Ternary Rare Gas Mixtures

B. N. SRIVASTAVA and S. C. SAXENA, Calcutta

The thermal conductivity of the binary gas mixtures Ne-A, Ne-Kr and A-Kr has been measured at 38°C for various concentrations by using the 'thick wire' variant of the 'hot wire' method. These data are likely to be of great use for gas analysis in the usual experiments on diffusion and thermal diffusion and have, therefore, been represented by semi-empirical equations giving the conductivity over the entire range of concentration. The experimental values of thermal conductivity have been compared with those calculated on the Lennard-Jones 12 : 6 model and the modified Buckingham Exp-Six model. A simple modification of the Lindsay-Bromley formula has been suggested and is found to reproduce the experimental data extremely well. The thermal conductivity of the ternary mixture Ne-A-Kr has also been measured for different compositions of the mixture.

### 4. Formulae for Thermal Conductivity of Ternary Gas Mixtures

B. N. SRIVASTAVA and S. C. SAXENA, Calcutta

The thermal conductivities of ternary mixtures of argon and krypton have been recently reported by the authors. In the present paper these values have been compared with those calculated from the two simple generalised expressions for the thermal conductivity of a ternary mixture, one of which is obtained from an extension of the Enskog's expressions for the binary thermal conductivity while the second from the Lindsay-Bromley formula. It is found that the latter generalisation yields values which are in better agreement with the experiment provided the two constants of the Lindsay-Bromley formula are experimentally determined.

### 5. Thermal Conductivity of Binary and Ternary Mixtures of Helium, Argon and Xenon

S. C. SAXENA, Calcutta

The thermal conductivities of the binary gas mixtures A-He, A-Xe and He-Xe have been determined for various concentrations by using the 'hot wire' method. The experimental values of thermal conductivity are in good agreement with the values calculated on the Chapman-Enskog theory for the Lennard-Jones 12-6 model. The experimental data over the entire range of concentration for each mixture have been formulated by means of an empirical equation containing two constants. These expressions will be of great use for gas analysis in the usual experiments on diffusion and



thermal diffusion. A simple modification of the Lindsay-Bromley formula suggested by Srivastava and Saxena is found to reproduce the experimental data extremely well. The thermal conductivities of the ternary mixtures of argon, helium and xenon have also been measured. The experimental values are found to be in good agreement with those calculated on the basis of a simple formula suggested by Srivastava and Saxena. The latter is obtained on the extension of a formula suggested by Lindsay and Bromley for binary mixtures to ternary mixtures.

## 6. Intermolecular Potentials for unlike interaction on Exp—Six model

K. P. SRIVASTAVA, Calcutta

The potential parameters for the unlike pairs of molecules A-He, A-Xe and Ne-Xe have been determined from the "exp-six" model from the temperature dependence of thermal diffusion of these gas mixtures following the method developed earlier by Srivastava and Madan. Unlike the graphical method of Srivastava and Srivastava a purely computational method has been employed here for determining the parameters  $\alpha_{12}$  and  $\epsilon_{12}$ . First coupled values of  $\alpha_{12}$  and  $\epsilon_{12}$  were determined by neglecting the temperature variation of the 'g' factor and using Kihara's first approximation formula. Then the absolute value of the 'g' factor was calculated at a fixed temperature for various values of  $\alpha_{12}$  and that value of  $\alpha_{12}$  selected which gave the experimental value of the thermal diffusion factor  $\alpha_T$ . Precise value of  $\epsilon_{12}$  was determined by taking into account the temperature variation of 'g'. The values of the potential parameters  $\alpha_{12}$ ,  $\epsilon_{12}$  and  $(\gamma_m)_{12}$  thus obtained were found to reproduce satisfactorily the experimental data on thermal diffusion except for very low temperatures where  $T^*$  is less than 1.5 and the "exp-six" law probably does not hold.

## 7. Heat Flow into Soil at Waltair

V. P. SUBRAHMANYAM and S. SUBBA RAO, Waltair

Soil temperatures at the Andhra University Meteorological Observatory were taken every hour for all the 24 hours on three different days in February, April and August, 1956. The hourly heat flux,  $q$ , into the soil at the soil-atmosphere interface was computed according to the equation

$$-k\rho c \left( \frac{\partial \tau}{\partial z} \right)_z$$

where  $k$  is the thermal diffusivity and  $\rho c$  is the heat capacity of the soil and  $\left( \frac{\partial \tau}{\partial z} \right)_z$  is the depth variation of temperature in the soil. The results were found to be comparable with those reported by Schreiber and Lettau.

Curves representing the diurnal variation of heat flux are presented. These curves show that a greater amount of heat is stored in April due to greater insolation while in February and August the stored heat energy is less on account of reduced insolation; in February, the insolation is less due to lower elevations of the sun while in August the increased cloudiness reduces both the incoming and outgoing radiation.

## 8. A Transistor as a Low Temperature Measuring Device

J. MAHANTY, S. MAHANTY and SHINTARO UDA, New Delhi

It is well known that the resistance of a semi-conductor increases at low temperatures. Utilizing this property, one can measure low temperatures. However, the semi-conductor is a two terminal device and no control element exists. On the contrary a transistor has three terminals, i.e., the emitter, collector, and base in which one of them can be used as a controlling electrode between input current and output current. This makes the transistor a better device than the two terminal semi-conductor device for measuring low temperatures. It has increased sensitivity and operating range.

Our experiments show, using several kinds of *p-n-p*-junction transistors made by different companies, that in some cases the collector current is exponentially related to the reciprocal of absolute temperature, and in others this relation is not held. At any rate, the relation between the current and reciprocal of temperature is non-linear. By employing some suitable electronic circuit of non-linear characteristics, it could be possible to get an output linearly related to reciprocal of temperature.

The paper illustrates one such method for getting a fairly good linearity for the range of 70°K–200°K.

## 9. A Study of Heat—Losses by Forced Convection

H. N. PATIL, Bombay and D. V. GOGATE, Baroda

In this paper, the effect of air-streams at low velocities ranging from 47 cm/sec. to 277 cm/sec. on the rate of convective heat transfer from spherical vessels of different sizes is studied and the experimental results are compared with those of other workers in the field. It is shown that for vessels of a spherical shape, the rate of heat dissipation is proportional to  $V^{0.61}$  where  $V$  is the velocity of the air-stream.

## III. Optics, Radiation, Spectra.

10. Theoretical and experimental study of intensity features in  $A^2\Delta \rightarrow X^2\Delta$  band system of VO

P. V. CHANDRATREYA, Bombay and N. R. TAWDE, Dharwar

Accurate theoretical and experimental data on transition probabilities has been obtained on the  $A \rightarrow X$  system of VO molecule by the use of Hutchisson's treatment. Comparison between the two sets of values shows that there is very little agreement between the two. The large disparities are ascribed to (a) asymmetry, (b) mechanical anharmonicity and also probably to (c) electrical anharmonicity, not considered in the treatment. There is experimental evidence for subsidiary parabola in the distribution, but the same is not confirmable by theory.

## 11. Hulbert and Hirschfelder Expression in the Isotopic Molecules of Hydrogen

M. R. KATTI and N. R. TAWDE, Dharwar

Following the claim made by Hulbert and Hirschfelder that the modified potential energy expression proposed by them should stand better test with employment of more

accurate experimental data, work has been carried out for  $H_2$  and its isotopic molecules with more refined constants that are now available. The results do not show any improvement over the position then outlined.

## 12. Transition Probabilities in $AlO$ : Extension to anharmonic conditions

V. M. KORWAR and N. R. TAWDE, Dharwar

The earlier theoretical study by Chandratreya under harmonic conditions for the bands of  $A^2\Sigma - X^2\Sigma$  system of  $AlO$  has been extended to anharmonic oscillations by the use of Bates' treatment. The results are studied in relation to the available values of Chandratreya and similar derivations from more recent mathematical technique of Manneback, under assumptions of harmonic character.

## 13. Some Theoretical Aspects of Transition Probabilities in $BeO$ ( $B^1\Sigma \rightarrow X^1\Sigma$ ) Bands

N. SREEDHARA MURTHY and N. R. TAWDE, Dharwar

The  $BeO$  molecule, among the series of astral molecules, has been chosen to evaluate theoretical transition probabilities with a view to predict the course of intensity distribution prevailing in stellar bands. As a first step in this study two theoretical treatments involving harmonic oscillation have been compared by taking help of bands  $B \rightarrow X$  system of  $BeO$ . One of these treatments is due to Hutchisson and the other to Manneback. The procedures in this latter treatment have been found to be easier and quicker than Hutchisson's. But the two lead to the same results. As a second step, the other two methods, viz., of Pillow and of Bates, which take account of anharmonicity correction in their own independent way have been examined. The derivations from these two differ to a certain extent among themselves. The points of agreement between experimental derivation and harmonic oscillator function on the one hand, and between experiment and anharmonic oscillator function on the other hand, have been critically discussed.

## 14. $r$ -Centroids of some Diatomic Molecules

B. S. PATIL and N. R. TAWDE, Dharwar

The  $r$ -centroid ( $\bar{r}_{v',v''}$ ), an average internuclear distance for the  $v' \rightarrow v''$  transition has been evaluated by using a graphical method for some bands of  $AlO$  ( $A^2\Sigma - X^2\Sigma$ ),  $CrO$  ( $A^6\Pi - X^6\Pi$ ) and  $CH$  ( $A^2\Delta - X^2\Pi$ ) and shown to satisfy the relation of Nicholls.

## 15. Note on Elliott's Derivation of Transition Probabilities in $\beta$ -system of $BO$

A. P. WALVEKAR and N. R. TAWDE, Dharwar

While attempting to subject the earlier results of Elliott on the transition probability in  $\beta$ -system of  $BO$  to modern treatments some disparities were noticed in his results and ours repeated now by fresh calculations. These have been attributed to

the erroneous method of interpreting the value of transition probability. The genesis of the interpretation is discussed and as a result of the one sought to be given, the theoretical predictions come to be in better agreement with experimental data.

#### 16. Observation on Band Spectrum of $S_2$

J. D. RANADE, INDRA DEV and R. K. SHRIVASTAVA, Sagar

While studying the absorption spectrum of  $HgS$ , it was found that the free sulphur, associated with  $HgS$ , always showed that  $(\nu'_{10})$  and  $(\nu'_{11})$  progressions of the well known band system  $B^3 \Sigma_u^- \leftarrow X^3 \Sigma_g^-$  in the ultraviolet. This disappears when the free sulphur is removed from  $HgS$  by suitable treatment. On measurement of these bands it was found that some new bands were obtained which are not included in standard tables giving the vibrational structure of the bands of these progressions. The table de constantes et donnees numeriques volume 4 (edited by B. Rosen and published by UNESCO) record bands up to (27,0) of the  $(\nu'_{10})$  progression. We have noted bands up to (30,0) in this progression and also some bands in the progression  $(\nu'_{11})$  which are also not recorded there. These are reported in this note.

#### 17. Secondary Interference of Diffraction Spectra Generated by Optical and Acoustical Gratings

GOPALA MENON SREEKANTATH, Trivandrum

When a plane wave front of monochromatic light of wavelength  $\lambda$  emerging from a narrow slit, is incident normally on a plane transmission grating—grating element  $\Delta$ —a system of interference bands spaced  $\Delta$  apart may be observed by an eye-piece, the visibility and definition of these bands occurring with every retreat of the eye-piece through a distance  $Z = \Delta^2/\lambda$ . In the case of an acoustical grating, produced by high frequency stationary sound waves of wavelength  $\Delta$  traversing a liquid, the value of  $Z$  is  $\Delta^2/2\lambda$  with bands spaced  $\Delta/2$  apart. It has been also observed that visibility of the bands occurred at intermediate distances  $\frac{1}{2}Z$ ,  $\frac{2}{3}Z$ , and  $\frac{3}{4}Z$  from the first nearest position where they appear, the band width becoming  $\Delta/4$ ,  $\Delta/6$  and  $\Delta/8$  respectively in these cases. A simple theoretical explanation is presented to account for these experimental results obtained by various investigators including the present writer.

#### 18. On the Temperature Dependence of Energy Transfer in Diphenyl-anthracene System

M. L. BHANUMIK and H. N. BOSE, Kharagpur

Energy transfer in organic phosphors has been a field of interesting speculation for a long time; different mechanisms for energy transfer in solid phosphors have been suggested by various authors and it has not yet been possible in many cases, to establish uniquely any particular mechanism from experimental observations. Measurements on the temperature dependence of energy transfer in organic phosphors have been undertaken in our laboratory and some preliminary results of such measurements on Diphenyl-anthracene system were reported earlier by J. Sharma and M. L. Bhanumik.

In the present paper results of more precise measurement from liquid  $N_2$  temperature to room temperature ( $30^\circ C$ ) have been reported. It has been found that energy transfer process, in this system at least, is more dependent on temperature at low concentrations of anthracene ( $> \sim 1\%$ ); at higher concentrations the process seems to be practically independent of temperature. The maximum distance between anthracene and diphenyl molecules is less than  $25 \pm 5$  A.U. (roughly), in the latter case; while in other cases when the energy transfer becomes dependent on temperature the maximum distance between the guest and host molecules is greater than  $25 \pm 5$  A.U. (roughly). In the light of "Resonance transfer" theory, the results have been interpreted to imply that direct transfer takes place over distances less than  $25 \pm 5$  A.U. while for greater distances transfer process takes place in steps through the host molecules; thus, even if energy transfer takes place by resonance process, efficiency of energy transfer may still be temperature dependent.

#### 19. Thermoluminescence and trapping mechanisms in LiF and para-Xylene

H. N. Bose and A. L. LASKAR, Kharagpur

In continuation of the earlier work of the present authors, the probability of escape (i.e. decay constant  $p = Se^{-E/KT}$ ) of electrons from a trap of depth ' $E$ ' has been determined for different temperatures from the thermoluminescence curve of LiF and  $p$ -Xylene; it has been found that in the case of LiF the variation of ' $p$ ' with temperature does not follow a simple exponential law; this is similar to the results reported earlier (Symposium of National Academy of Science, Lucknow, 1955) in the case of sodium chloride. In case of  $p$ -Xylene, however, temperature variation of ' $p$ ' seems to be nearly exponential within the experimental error. The results thus confirm the conclusion that the trapping mechanisms and trapping states being intimately connected with the colour centres in alkali halides, the trap depth ' $E$ ' may depend on temperature; in case of organic phosphors, however, phosphorescence being due to metastable states, ' $E$ ' as well as ' $S$ ' can be expected to be temperature independent.

#### 20. Optical and Electrical Methods of Measuring Thickness of thin Metallic films

Y. G. NAIK and E. M. BALSARA, Cuttack

Measurements of thicknesses of chemically deposited thin films of silver are made from (i) the study of the absorption of light and (ii) from the electrical conductivity of these films. It is shown that the thicknesses determined are of the same orders if the electron diffusion coefficient is  $\frac{1}{2}$  and not 0. A method has been indicated to determine the value of this co-efficient.

#### 21. The absorption spectra of NaCl-TiCl solution

H. N. Bose and S. C. SEN, Kharagpur

The absorption spectra of aqueous solutions of KCl containing small amount of TiCl consist of a band with a maximum at  $240m\mu$  while in the case of single crystal of KCl, containing traces of  $Ti^{3+}$  as impurity, the absorption spectra show two bands

with maxima at  $247m\mu$  and  $195m\mu$ ; the absorption and luminescence spectra in the latter case have been shown by Williams to be due to the energy levels of Tl modified by KCl Lattice. When thallium concentration is large, longwavelength emission is obtained in luminescence and the shortwavelength emission is suppressed. Several authors have concluded from these results that complex formation takes place in KCl-TlCl system in aqueous solution as well as in the solid state. In the present investigation molar absorptivities of  $Tl^+$ ,  $TlCl$ , and  $TlCl_2^-$  have been determined for different wavelength, from the measurements of absorption curves of aqueous solutions of NaCl-TlCl. The absorption curve for any concentration of the solution can then be theoretically calculated; theoretical curve so obtained agrees quite well with the experimental curve. The results of the present investigation have been found to be in general agreement with the idea of complex formation in aqueous solutions of NaCl-TlCl.

## 22. Hindered Rotation in Methyl Alcohol

B. V. GOKHALE and A. MOZUMDER, Kharagpur

The theory of internal rotation in methyl alcohol has been discussed by Dennison & Koehler (*Phys. Rev.*, **57**, 1006, 1940) and recently by Denison & Burkhard (*Phys. Rev.*, **84**, 408, 1951) for the purpose of interpreting its microwave absorption spectrum. In this paper, we develop a simpler theory along the lines indicated by one of us (B.V.G.) at the 1953 session of the Indian Science Congress held at Hyderabad. Dennison *et al* have postulated a sinusoidal hindering potential barrier. This leads to great complexity of calculation. In order to better visualise the general nature of the phenomenon, we have used a potential barrier of the nature of a Dirac- $\delta$ -function.

This leads to the simple eigenvalue equation  $-\frac{\theta\pi}{3} \cdot \frac{\sin x}{x} + \cos x = \cos \lambda$  where

$\theta$  is proportional to the area under the potential barrier and  $x$  is proportional to the square root of energy,  $\lambda$  being a structure dependent parameter. The choice of this barrier also simplifies the perturbation calculation very considerably. It has been found that a choice of  $\theta = 16.25$  gives a microwave transition in the right range (of around 25 KMC/S) from the state  $K = 1, n = 2$ , to  $K = 2, n = 0$ .

## 23. Additional Bands in the Absorption Spectrum of Formaldehyde

I. ACHYUTA RAO and V. RAMAKRISHNA RAO, Waltair

With a 150 cm. path length at the saturated vapour pressures corresponding to 80-200°C, Formaldehyde was found to give seven new bands in the positions (27624, 27578), (27427, 27389), 26595, (26392, 26343)\*, 25953\*, (25759, 25700)\*, (25220, 25150)\*  $cm^{-1}$ . The bracketed bands are measured as doublets while those with asterisks are common to the emission spectrum. The band at 26595  $cm^{-1}$  shifted from the A band (28314  $cm^{-1}$ ) by 1719  $cm^{-1}$  represents the (0,1) band of  $C=O$  vibration. The  $\alpha$ -band (26990  $cm^{-1}$ ) shifted by 1324  $cm^{-1}$  from the A band and occurring as an overtone and combination with 1719 could be taken as another (0,1) band. These observations justify the choice of the A band occurring both in fluorescence and absorption as the (0,0) for this system. Three Upper state fundamentals 1177 (B), 840 (B') and 2554 (D'') explain the bands to the violet of A. The first two correspond to 1719 and 1324 respectively. 2543 may be a C-H stretching frequency. These features besides

the even overtones of  $\nu_2$  observed in the fluorescence spectrum impart the characteristics of an allowed transition to this system of Formaldehyde.

1. A. D. Walsh, *J. Chem. Soc.* 2308, 1953, and other references cited there.

## 24. Absorption and Fluorescence Spectra of Uranyl Salt Solutions

D. D. PANT and D. P. KHANDELWAL, Naini Tal

The fluorescence and absorption spectra of uranyl acetate, nitrate and sulphate have been studied in solutions of various dilutions. The absorption spectra as scanned with a spectrophotometer show the usual structure in both nitrate and sulphate, while in acetate the bands are more diffuse, those belonging to the ultraviolet (below about 3800Å) being absent. The fluorescence of solutions, as measured by a photomultiplier, shows resolved structure (similar to that observed in the solid state) in the case of sulphate, while in the case of acetate only a continuum is observed. The nitrate solution shows an intermediate structure. The nature of the spectra has been explained on the basis of hydrolysis in the solutions. Other data, *e.g.*, pH, fluorescence intensity, absorption coefficient, etc., have been obtained and correlated with the behaviour of the spectra. The solutions of acetate and nitrate also show an aging effect in fluorescence in as much as they develop a resolved structure on standing.

## 25. Raman Spectra of Amino Acids

K. VENKATESWARLU and P. T. SAMBANDAM, Annamalaiagar

A systematic study of the Raman spectra of aminoacids both in the solid and in the solution states has been taken up. The Hilger Raman Spectrograph with the attached Raman Source has been used in this investigation. The frequencies obtained in three substances in the solid state are reported here—

Norleucine :— 56, 104, 503, 541, 668, 699, 771, 800, 852, 894, 916, 1050, 1388, 1456, 1532, 1594, 1672, 1961, 3002, 3039, 3072  $\text{cm}^{-1}$ .

Glutamic Acid :—503, 559, 666, 701, 770, 800, 833, 851, 894, 906, 954, 1054, 1200, 1237, 1304, 1387, 1413, 1455, 1532, 1608, 1635, 1833  $\text{cm}^{-1}$ .

Methionine :— 425, 506, 583, 669, 701, 714, 774, 803, 850, 854, 895, 909, 974, 1190, 1207, 1457, 1515, 1621  $\text{cm}^{-1}$ .

## 26. Force Constants of $\text{AsH}_3$ , $\text{AsD}_3$ , $\text{SbH}_3$ and $\text{SbD}_3$

K. VENKATESWARLU and S. SUNDARAM, Annamalaiagar

The Wilson's F-G matrix method has been applied to the pyramidal molecules  $\text{AsH}_3$ ,  $\text{AsD}_3$ ,  $\text{SbH}_3$  and  $\text{SbD}_3$  and the force constants in them have been evaluated from their vibration frequencies. The force constants (in  $10^5 \text{ dyne cm}^{-1}$ ) in the various cases are :

$\text{AsH}_3$ :	$f_d = 2.8970$ ,	$f_a = 0.2848$ ,	$f_{dd} = -0.0100$ ,	$f_{aa} = 0.0052$
$\text{AsD}_3$ :	$f_d = 2.8837$ ,	$f_a = 0.2868$ ,	$f_{dd} = -0.0143$ ,	$f_{aa} = 0.0027$
$\text{SbH}_3$ :	$f_d = 2.3733$ ,	$f_a = 0.1938$ ,	$f_{dd} = -0.0197$ ,	$f_{aa} = -0.0018$
$\text{SbD}_3$ :	$f_d = 2.3093$ ,	$f_a = 0.2030$ ,	$f_{dd} = 0.0073$ ,	$f_{aa} = -0.0061$

## 27. The Zeeman Effect in the OD Bands

NAND LAL SINGH, Banaras

A High frequency discharge through  $D_2O$  vapour subjected to constant magnetic fields has been studied with a 35 ft. Grating Spectrograph (Paschen Mounting). The rotational structure of the ultraviolet bands of OD show different but interesting splitting under the fields. The lines have been considered into three groups :

- (a) Lines near the origin for which the fine structure is resolved,
- (b) Intermediate lines for which complete field-patterns are observable,
- and (c) Lines with higher  $J$  values for which the intense parts of patterns are observed.

These patterns are described and splittings measured. The results obtained are compared with the existing theory<sup>1</sup>.

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28. Rotational Analysis of  $\beta$  and  $\gamma$  Bands of PO Molecule

NAND LAL SINGH, Banaras

The  $\beta$  bands of PO molecule have been photographed on 35 ft. grating spectrograph at the National Research Council, Ottawa (Canada). The resolved structure reveals clearly the presence of six branches : three going to the shorter wavelengths and three to the longer wavelength side from the origin. Analysis shows that the transition involved is  $(2\Sigma \rightarrow 2\pi)$  and not  $(2\pi \rightarrow 2\pi)$ , as proposed by Herzberg & Herrberg<sup>2</sup>.

The final level  $2\pi$  is also involved in the  $\gamma$  system of the molecule. There is, however, some discrepancy in the rotational constants as compared to those obtained by Sen Gupta from the analysis of  $\gamma$  bands<sup>1</sup>. Rotational analysis for both the system will be presented.

Further work to resolve the discrepancies is in progress.

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## IV. Meteorology.

## 29. An unusual case of widespread thunderstorm activity in peninsular India on June 1956.

Y. P. RAO and P. S. HARIHARAN

Widespread thundershowers occurred in the Peninsular India, with heavy rain at a few places, during the twentyfour hours ending 0300 GMT of the 14th June, 1956. The synoptic situation on the previous morning was marked by conspicuous northerly flow upto six kilometres. This flow apparently resulted from 'in-phase superposition' of an upper level trough over the central and south Bay of Bengal and another over Uttar Pradesh. It is suggested that the mid-tropospheric divergence associated with such northerly flow was mainly responsible for the extensive thundershowers,



30. Simultaneous recording of atmospherics on four different wavebands in the longwave region

M. W. CHIPLONKAR and V. N. ATHAVALE, Poona

With a view to study the variations in the intensity and the number of atmospherics received per second in the longwave region four narrow band t.r.f. receivers were designed and constructed. These four bands are 85 kc/s, 125 kc/s, 175 kc/s and 455 kc/s respectively. The output of the receivers were given to the X plates of four identical cathode ray tubes. A moving plate camera with a  $f/2.5$  lens recorded simultaneously the deflections of all the C.R.O. spots. Records of one minute duration were taken at two or three fixed hours during the night. In all over sixty plates were obtained during the period March 1956 to June, 1956. The plates were measured to give intensities and number of atmospherics per second on the four bands. The results were analysed statistically and summarised in tables and are presented in the form of monthly and hourly graphs showing variations of these quantities with frequency and the season. In general the number and intensity is found to decrease with increasing carrier frequency. The work is being continued.

31. The Night Air Glow

M. W. CHIPLONKAR and P. V. KULKARNI, Poona

A photomultiplier type of photometer suitable for intensity measurement of the night air glow was designed and built. The photomultiplier tube type 931 A, R.C.A. kept at the focus of a large convex lens was fitted on an alt-azimuth mount. The photomultiplier output was given to the Y plates of a DuMont 304A cathode Ray Oscilloscope which has a four stage d.c. amplifier. Using the monochromatic interference filters passing wavelengths 5577A and 4358A alternately on the photomultiplier the whole sky was scanned, systematically several times during a night. The instrument was calibrated against a standard Kodak acetylene lamp and all readings were converted and expressed in units of mega quanta/cm<sup>2</sup>. sec. Two methods were employed to study the intensity variations in the night air glow:- (1). In the first method for complete scanning of the sky a zenithal projection map was prepared and isophot lines drawn to bring out the brighter and lighter portions of the sky. Such a picture represents approximately an instantaneous condition of the sky. (2) In the second method time variations of the intensity in the 7° wide north-south belt of the sky were shown at successive intervals during a whole night. Isophot lines drawn on such a diagram serve to bring out the time variations in the meridian section of the atmosphere.

The results obtained during 10 clear nights of January, February and March 1956 show that the maximum and minimum values of intensity of  $\lambda$  5577A after correction for the background were 150 and 500 mega quanta/cm<sup>2</sup>. sec. which are practically identical with those obtained by Roach and Pettit in the U. S. A.

V. X-rays, Cathode Rays, Structure of Solids.

32. An X-ray Diffraction Study of the Mineral 'Royite'

B. S. BASAK and S. N. MITRA, Dhanbad

An x-ray diffraction study of 'Royite' from different angles has been carried out. This mineral, which was discovered in the eastern portion of the Jharia Coalfield by

Professor N. L. Sharma is brownish-black or black in colour and differed in many of its properties from quartz and as such was given the name 'Royite' after the name of Dr. S. K. Roy., one of the collaborators of its said study.

A powder photograph of the sample in a 19 cm. Bradley camera with copper radiation shows that all the lines therein can be explained on the assumption that 'Royite' is pure  $\alpha$ -quartz. Analysis of the sample by the method of 'internal standard' of Clark and Reynolds shows that Royite does not contain appreciable quantities of impurities. From a spectrographic analysis the previous workers found 1.80 and 2.04 percents of alumina and magnesia respectively in Royite. But in the present x-ray photograph of the sample there were no traces of lines due to them. Moreover a photograph of a mixture of alumina and magnesia in above percentages in pure quartz showed distinct, though faint, traces of lines due to these impurities. This indicated the absence of alumina and magnesia in 'Royite' at least in percentages indicated above.

The mineral consists of fairly good single crystal and not polycrystalline aggregates as demonstrated by a Laue Photograph. And the colour of it is due to the presence of thin flakes of Biotite distributed in the interstices of the main crystalline matrix.

### 33. Particle size and line profile of a triclinic parallelepiped

G. B. MITRA, Kharagpur

Expressions for the particle size and line profile of a powder aggregate of triclinic parallelepipeds have been derived in terms of X-ray diffraction observables. Taking the axes of the triclinic crystal as the axes of reference, the volume common to the triclinic parallelepiped and its ghost shifted through a distance  $t$  has been calculated and then integrated with respect to ' $t$ ' between the limits where the common volume vanishes. This divided by the volume of the parallelepiped gives us the apparent thickness which is experimentally observable in terms of Scherrer formula. Thus an expression is obtained connecting the particle geometry and the apparent thickness from which the particle size parameters can be easily determined. Substituting the cubic conditions in this expression Stokes and Wilson's formula is readily derived. Similarly, substituting the conditions for an orthorhombic cell in the expression, Laue's formula for particle size is obtained. Adopting the method due to Wilson, an expression has also been derived for the line profile of the  $hkl$  reflection in terms of the particle size parameters.

### 34. Errors in the measurement of lattice constants by high temperature X-ray powder photography

S. K. MITRA, Kharagpur

Although various sources of errors in the evaluation of lattice spacings by the X-ray powder diffraction method have been investigated by different authors, two sources have not yet been discussed. These are the departure from verticality of the sample stick and the absorption displacement of the  $cg$  of the line blackening due to samples of elliptic cross section. Expressions have been derived for correcting for these two sources of error. It is seen that the verticality error leads to line broadening as well as dense packing of lines on one side of the (000) diffraction line while on the other side, the lines will have comparatively large separation.

### 35. Determination of the Thermal Expansion of Cu-Al alloys by the X-ray Diffraction Method

G. B. MITRA and S. K. MITRA, Kharagpur

The coefficient of thermal expansion of polycrystalline 4% Cu-96% Al alloy from room temperature to 450°C has been determined by the X-ray diffraction method. The coefficient of thermal expansion between room temperature and 250°C has been found to be  $18 \times 10^{-6}$  per °C which is nearly the same as the published value for duraluminium determined dilatometrically. After 250°C it increases considerably and attains the value  $44.2 \times 10^{-6}$  between 250°C and 350°C and then falls down to  $30.8 \times 10^{-6}$  between 350°C to 450°C. The abrupt increase in the coefficient of thermal expansion after 250°C has been explained on the basis of the order-disorder change at that temperature.

### 36. Anisotropy in absorption of aromatic single crystals

S. C. GANGULY, N. K. CHAUDHURY and BISHNU CHARAN MUKHERJEE,  
Calcutta

In some previous communications<sup>1</sup> it has been shown that in these crystals the intensities of polarized fluorescence in different perpendicular directions are different. From the measurement of intensity of polarised light emitted by the molecules of the crystals, under ultra-violet excitations, it was possible to determine the molecular orientations of these crystals. This study was also helpful to determine the lowest electronic states of the molecules<sup>2</sup>.

These crystals show anisotropy<sup>3</sup> in absorption also. A very thin crystalline film of anthracene was taken for investigations and light was allowed to be incident on the *c* face with *b* axis vertical. The ratio of absorption at 3663 Å along *b* to that along *a* was measured and the result was found to be 1.51. It may be mentioned that the corresponding photocurrent ratio is in perfect agreement with this. Further it may be added that the corresponding intensity ratio of the fluorescence band was found to be 3.3 in this laboratory.

Full details with implications of these results will be discussed soon.

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### 37. X-ray Investigation of Hydrocarbons

N. N. GUPTA, Calcutta

X-ray study of some solid hydrocarbons has been made. It has been found that the axes of hydrocarbon molecules are at right angles to one particular set of Bragg

planes. It has also been possible to investigate that the carbon atoms form a regular zig-zag chain making an angle of  $112^{\circ}40'6''$ .

### 38. Crystal structure of Copper Manganite — $\text{CuMn}_2\text{O}_4$

A. P. B. SINHA, N. R. SANJANA and A. B. BISWAS, Poona

Copper manganite has been prepared by the reaction  $\text{CuO} + \text{Mn}_2\text{O}_3 = \text{CuMn}_2\text{O}_4$ . The crystal structure has been determined from the X-ray powder diffraction data.

The unit cell is cubic with  $a = 8.33 \pm .01 \text{ \AA}$ ;  $Z = 8$ ;  $D_{\text{calc.}} (\text{X-ray}) = 5.45 \text{ g/cm}^3$ , and  $D_{\text{obs.}} = 5.23 \text{ g/cm}^3$ ; space group  $= O_h^7 = \text{Fd}\bar{3}\text{m}$  and the co-ordinates of the atoms: 8 Cu ions at (a):  $000, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$  f.c.c.; 16 Mn ions at (d):  $\frac{5}{8}, \frac{5}{8}, \frac{5}{8}; \frac{5}{8}, \frac{7}{8}, \frac{7}{8}; \frac{7}{8}, \frac{5}{8}, \frac{7}{8}; \frac{7}{8}, \frac{7}{8}, \frac{5}{8}$  f.c.c.; and 32  $\text{O}^{2-}$  at (e):  $u, u, u; u, \bar{u}, \bar{u}; \bar{u}, u, \bar{u}; \bar{u}, \bar{u}, u; \frac{1}{2} - u, \frac{1}{2} - u, \frac{1}{2} - u; \frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2} + u; \frac{1}{2} + u, \frac{1}{2} - u, \frac{1}{2} + u; \frac{1}{2} + u, \frac{1}{2} + u, \frac{1}{2} - u$  and f.c.c. The best fit between the observed and calculated intensities is obtained when  $u = 0.389$ .

Both  $\text{Mn}^{3+}(\text{d}^4)$  ions and cupric ions ( $\text{d}^9$ ) form strong square covalent bonds ( $\text{dsp}^2$ ,  $\text{Cu} > \text{Mn}$ ), suggesting that the  $\text{Cu}^{2+}$  ion should be in the octahedral site and the copper manganite lattice tetragonal. However, the Cu ions are found to occupy the tetrahedral sites and the crystal lattice is cubic. The results have been explained on the basis of an electron transfer process



where  $\text{Cu}^+$  ions ( $\text{d}^{10}$ ) are stabilised in the tetrahedral sites through hybridised  $\text{sp}^3$  bond orbitals.  $\text{Mn}^{4+}$  ions ( $\text{d}^3$ ) form six hybridised  $\text{d}^2\text{sp}^3$  bonds at the octahedral sites and hence do not contribute to any distortion since they are all equivalent. The square bond forming  $\text{Mn}^{3+}$  ions occupies only 25 per cent of the available octahedral sites, but no distortion of the lattice was observable. This suggests that for an observable tetragonal distortion to occur in the bulk lattice, more than 25 per cent of the octahedral sites must have square bond-forming cations.

### 39. Crystal structure of Nickel Manganite — $\text{NiMn}_2\text{O}_4$

A. P. B. SINHA, N. R. SANJANA and A. B. BISWAS, Poona

The crystal structure of nickel manganite  $\text{NiO} \cdot \text{Mn}_2\text{O}_3$  formed by the solid-state reaction has been determined from X-ray powder data. The unit cell is cubic with  $a = 8.37 \pm .01 \text{ \AA}$ ,  $Z = 8$ ,  $D_{\text{obs.}} = 5.33 \text{ g/cm}^3$ ,  $D_{\text{calc.}} (\text{X-ray}) = 5.27 \text{ g/cm}^3$ ; space group  $= O_h^7 = \text{Fd}\bar{3}\text{m}$  with the following atomic arrangements: 8 Mn ions at position (a)  $0, 0, 0, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$  f.c.c., 8 Mn and 8 Ni ions distributed statistically over the 16(d):  $\frac{5}{8}, \frac{5}{8}, \frac{5}{8}; \frac{5}{8}, \frac{7}{8}, \frac{7}{8}; \frac{7}{8}, \frac{5}{8}, \frac{7}{8}; \frac{7}{8}, \frac{7}{8}, \frac{5}{8}$  f.c.c. and 32  $\text{O}^{2-}$  at positions (e):  $u, u, u; u, \bar{u}, \bar{u}; \bar{u}, u, \bar{u}; \bar{u}, \bar{u}, u; \frac{1}{2} - u, \frac{1}{2} - u, \frac{1}{2} - u; \frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2} + u; \frac{1}{2} + u, \frac{1}{2} - u, \frac{1}{2} + u; \frac{1}{2} + u, \frac{1}{2} + u, \frac{1}{2} - u$  f.c.c. The best fit with the X-ray intensities is given by  $u = 0.382 \pm 0.003$ .

From the electronic configuration of the cations and their  $d$ ,  $s$  and  $p$  hybrid bond-forming powers it is deduced that eight of the sixteen  $\text{Mn}^{3+}(\text{d}^4)$  share the octahedral interstices of the cubic close-packed oxygen ions with the  $\text{Ni}^{2+}(\text{d}^8)$  ions.  $\text{Mn}^{3+}(\text{d}^4)$  has a strong tendency to form square bonds by hybridization of  $\text{dsp}^2$  empty orbitals, one-half of the manganese ions thus being stabilised in octahedral interstices. The  $\text{Ni}^{2+}(\text{d}^8)$  are stabilised through strong octahedral  $\text{sp}^3\text{d}^2$  hybridised bonds. The tetra-

hedral sites are occupied by the remaining eight  $\text{Mn}^{2+}$  through the formation of mixed ionic and covalent bond types. The distortion from a cubic to tetragonal lattice which normally occurs when a spinel lattice contains square, covalent bond-forming  $\text{Mn}^{2+}$  in the octahedral interstices, is not observed in this case, due to the fact that only one quarter of the available octahedral interstices are occupied by the  $\text{Mn}^{2+}$  ions.

#### 40. The Crystal Structure of Cobalt Manganite— $\text{CoMn}_2\text{O}_4$

A. P. B. SINHA, A. B. BISWAS and N. R. SANJANA, Poona

Cobalt manganite  $\text{CoO.Mn}_2\text{O}_3$  was prepared by solid-state reaction. The crystal structure was determined from X-ray powder data. The unit cell is tetragonal with  $a = 5.70 \text{ \AA}$ ,  $c = 9.04 \text{ \AA}$  and  $c/a = 1.585$ ;  $Z=4$ , and the space group  $I_{41}/amd-D_{4h}^{19}$  with the atomic co-ordinates: (0 0 0,  $\frac{1}{2}$   $\frac{1}{2}$   $\frac{1}{2}$ )  $\div$  Co atoms at 4(a): 0 0 0, 0  $\frac{1}{2}$   $\frac{1}{2}$ ; Mn atoms at 8(d): 0  $\frac{1}{4}$   $\frac{5}{8}$ , 0  $\frac{3}{4}$   $\frac{5}{8}$ ,  $\frac{1}{4}$  0  $\frac{3}{8}$  and  $\frac{3}{4}$  0  $\frac{3}{8}$ ; Oxygen atoms at 16(h):  $0 \ x \ z$ ,  $0 \ \bar{x} \ z$ , 0  $\frac{1}{2}+x$   $\frac{1}{2}-z$ , 0  $\frac{1}{2}-x$   $\frac{1}{2}-z$ ,  $x \ 0 \ z$ ,  $\bar{x} \ 0 \ z$ ,  $x \ \frac{1}{2} \ \frac{1}{2}+z$ , and  $\bar{x} \ \frac{1}{2} \ \frac{1}{2}-z$ , where  $x$  and  $z$  are approximately 0.24 and 0.380 respectively.

The scattering powers of Co and Mn are so similar that the reflection intensities do not indicate whether the metal ions are distributed in a 'normal' or 'inverse' way. However, from their electronic configurations and  $d$ ,  $s$  and  $p$  bond-forming powers it has been deduced that the arrangement is of the 'normal' spinel type, i.e., the  $\text{Co}^{2+}$  ions occupy the tetrahedral sites and the  $\text{Mn}^{2+}$  ( $d^4$ ) ions form square bonds by hybridization of empty  $dsp^2$  orbitals and are thus stabilized in the octahedral interstices. Four of the six octahedrally directed bonds are covalent, coplanar and the remaining two are ionic and linear. The covalent bonds are shorter than the linear ones, which accounts for the distortion from cubic to tetragonal symmetry.

#### 41. X-ray Investigation of Nickel-Tellurium System

R. P. AGARWALA,\* Bombay and A. P. B. SINHA,\*\* Poona

X-ray powder patterns were obtained from the solid products formed after reacting mixtures of nickel and tellurium in the ratio of 50 to 90 atomic percentages of nickel at  $580^\circ\text{C}$ . Within this range of composition two definite compounds,  $\text{NiTe}$  and  $\text{Ni}_3\text{Te}_2$  were identified. Both have hexagonal symmetry;  $a(\text{NiTe}) = 3.96 \text{ \AA}$ ,  $c = 5.35 \text{ \AA}$ ,  $c/a = 1.35$ ; and  $a(\text{Ni}_3\text{Te}_2) = 6.20 \text{ \AA}$ ,  $c = 8.60 \text{ \AA}$ ,  $c/a = 1.30$ . The transition from one phase to another is not gradual and at intermediate compositions both structures were found to coexist in cooled reaction products. On continued heatings at  $580^\circ\text{C}$ , the two compounds react in the solid state to give a new compound of the empirical formula  $\text{Ni}_{1.22}\text{Te}$ , the structure of which is isomorphous with  $\text{Ni}_{1.20}\text{S}$ ,  $\text{Ni}_{1.17}\text{S}$  and  $\text{Co}_{1.12}\text{S}$ , which are cubic with 'a' of the order of  $10\text{\AA}$  and the space group  $\text{Fm}\bar{3}\text{m}$ .

#### 42. The Crystal Structure of Oxamic Acid— $\text{HOOC.CO.NH}_2$

N. R. SANJANA, A. P. B. SINHA and A. B. BISWAS, Poona

The crystal structure of oxamic acid was determined from the X-ray powder and rotation-oscillation patterns of a single crystal around its three principal axes. The

unit cell is orthorhombic with  $a = 11.280 \text{ \AA}$ ;  $b = 12.450 \text{ \AA}$ ;  $c = 6.995 \text{ \AA}$ ;  $Z = 8$ , and the space group:  $P_{212121} - D_8^4$ . Microanalysis gave two molecules of water of crystallisation, hence  $D_{calc.} (\text{X-ray}) = 1.69 \text{ g/cm}^3$  and  $D_{obs.} = 1.63 \text{ gm/cm}^3$ .

#### 43. The Structure and Crystallisation of Amorphous Tin monoxide

A. P. B. SINHA, Poona

Tin monoxide was vapourised in vacuo onto a rocksalt cleavage face maintained at various temperatures, and the deposit structure determined by electron diffraction. The deposit was amorphous below  $180 \pm 10^\circ\text{C}$  and crystalline above that temperature. Amorphous  $\text{SnO}$ , formed as a surface film on a solution of weakly acidified tin salts exposed to ammonia vapour crystallised at  $100^\circ\text{C}$ . Thus the mode of preparation affects the temperature of crystallisation.

The positions and the intensities of various haloes in the diffraction pattern from the amorphous deposit have been analysed. They correspond closely to those of the diffraction ring groups from the polycrystalline  $\text{SnO}$ , which indicates that in amorphous  $\text{SnO}$  the atomic arrangement corresponds to that of the crystalline state though there may not be sufficient repeat to form a true lattice.

The lattice parameters of the tetragonal form of  $\text{SnO}$  have been determined from the diffraction pattern using  $\text{NaCl}$  rings as calibration standard. The values are  $a = 3.810 \pm .005 \text{ \AA}$ ,  $c = 4.835 \pm .005 \text{ \AA}$ ,  $c/a = 1.269$ .

#### 44. On the Reduction of Cupric Oxide to Cuprous Oxide in Vacuo

A. GOSWAMI and Y. N. TREHAN, Poona

The effect of thermal treatment of cupric oxide at  $350^\circ\text{C}$  in low pressures ( $\sim 10^{-2}$  mm Hg), both in the presence and absence of metallic copper, has been studied by electron diffraction. Contrary to the view that, at lower temperatures and pressures, the change from cupric to cuprous oxide occurs through the reaction  $\text{CuO} + \text{Cu} \rightarrow \text{Cu}_2\text{O}$ , it has been found that cuprous oxide is formed even in the absence of the free metal. The reaction  $4\text{CuO} \rightarrow 2\text{Cu}_2\text{O} + \text{O}_2$ , is known to take place at  $1050^\circ\text{C}$  at atmospheric pressure. The present results show that in accordance with the law of mass action the same reaction is brought about at much lower temperatures in reduced pressures.

#### 45. Growth of Orientated Nickel Oxide Deposits

A. P. B. SINHA, Poona

Nickel oxide ( $\text{NiO}$ ) films were grown from vapour phase onto glass and rocksalt cleavage face substrates kept at different temperatures and their orientation has been studied by electron diffraction. Above  $150^\circ\text{C}$  the deposit on glass develops a mixture of  $\{111\}$  and  $\{100\}$  one-degree orientation. The axis of orientation, however, is not exactly normal to the substrate but inclined by about  $5^\circ$  towards the vapour stream direction. On a rocksalt cleavage face the following orientations were observed at different temperatures.

$150^\circ\text{C}$ —One-degree  $\{111\}$  and  $\{100\}$ .

$250^\circ\text{C}$ —Mostly random with faint indication of  $\{100\}$  one-degree orientation.

400°C.—Two-degree orientation NiO (001), [100] parallel to NaCl (001) [100].  
 500°C.—The same as 400°C.

The change from one-degree through random to two-degree orientation with temperature has been explained on a basis of the surface textural changes occurring during deposition.

## VI. Magnetism.

### 46. Magnetic Susceptibilities of Selfactivated Zinc Sulphide Phosphors

H. N. BOSE and AMALENDU CHOWDHURY, Kharagpur

Although a large amount of work has been carried out on the various aspects of luminescence of solids, the nature of the luminescent centres and the mechanism of emission is not clearly known in many cases. It is felt that magnetic measurement on phosphors can serve as a useful tool in this respect and can help considerably in understanding the nature of the luminescent centres; but such measurements have as yet received very limited attention. In view of this possibility, a systematic investigation on the measurement of magnetic susceptibility of phosphors under different conditions have been undertaken. In the present paper such measurements on ZnS phosphors on activation by heat treatment have been reported.

ZnS precipitated from solution is practically nonluminescent but can be made luminescent by firing at higher temperature. The nature of the luminescent centres of so called 'selfactivated' ZnS has been for a long time a subject of many speculations. Recently it has been proposed that anion vacancies which have lost one electron ( $V_A^+$ ) (or anion vacancies,  $V_A^-$  that have trapped one electron depending on the nature of atmosphere during firing) are responsible for the luminescence of these phosphors. Such vacancies ( $V_A^+$  and  $V_A^-$ ) are expected to behave as paramagnetic centres and thus, the creation of these centers should be reflected on the magnetic behaviour of the phosphor. Measurements of the magnetic susceptibilities of non-luminescent ZnS fired at different temperatures in air or nitrogen atmosphere, show that the samples become less diamagnetic for higher temperatures obviously due to the contribution of the paramagnetic centres; also the luminescence yield of the samples increase at the same time. Thus the result of the present investigation also indicate the creation of paramagnetic centres in selfactivated ZnS and thus are consistent with the model proposed for the luminescent centres in this phosphor.

The effect of the adsorbed gases as well as that of the atmosphere during firing has also been observed and discussed.

### 47. Diamagnetic susceptibility of some essential oils

K. VENKATESWARLU and S. SRIRAMAN, Annamalaiangar

The diamagnetic susceptibilities of some of the essential oils and three of their chief constituents were determined using the Gouy method. The densities and their refractive indices were also determined and recorded. The diamagnetic susceptibilities of eucalyptus, cajaputi, aniseed, citronella and coriandri oils are  $0.7344$ ,  $0.7325$ ,  $0.6513$ ,  $0.6944$  and  $0.7212 \times 10^{-6}$  C.G.S. units and those of geraniol, anethole and cineole are  $0.7376$ ,  $0.6607$  and  $0.7470 \times 10^{-6}$  C.G.S. units respectively.



48. Feeble Paramagnetism of Rutile ( $\text{TiO}_2$ )

B. S. MOHANTY, Cuttack

Datar and Datar, 1949 have suggested the source of feeble paramagnetism in Chromium trioxide to be due to resonance existing between two possible states of Chromium trioxide. The paramagnetic susceptibility of Rutile is  $0.060 \times 10^{-6}$  (International Critical Tables). Here an attempt is made to calculate the paramagnetic susceptibility of Rutile by postulating an intermediary stage, where the spin is not paired. Calculating the amount of unpaired spin an estimate for the specific susceptibility of the compound is made. A good agreement between the calculated and the experimental values is obtained.

## 49. Magnetic Crochets at Alibag during Solar Flares

S. L. MALURKAR and M. PANDURANGA RAO, Bombay

For more than twenty years, it has been known that small well-distinguishable peaks or dips have occurred at the time of Solar Flares or Chromospheric eruptions. Radio Fade outs were also observed often at about the same epoch. From an extensive study, it has been known that these magnetic crochets are observed only in the day light hemisphere and decrease in magnitude with increase of distance from the sub-solar point. The crochet itself is expected align itself as to magnify the diurnal effect i.e., in the horizontal force, the force increases if the diurnal tendency is to increase at that time and the force decreases when the diurnal tendency is to decrease.

It was considered that an investigation from the observations of one observatory over a period should be looked into. The observed solar Flares for most of the astronomical observatories are published in the Quarterly Bulletins of the International Astronomical Union (Zurich). These were compared with the actual magnetic records. The magnetic records are often disturbed and many of the solar flares do not produce appreciable effects on the magnetograms. But after comparing for a period of over ten years to come across genuine solar flare crochets, and a tabular study was made.

At Alibag the diurnal tendency of the earth's magnetic horizontal force is a maximum slightly before local noon and for vertical force a minimum.

The tabular statement showed that the change in  $H$  was positive whether before or after the local noon. No marked crochet with a negative  $\Delta H$  was noticed. The crochet in the vertical field showed a decrease in vertical force ( $Z$ ) and the order of displacement though less than in  $H$  was of nearly same order of magnitude.

## 50. Minor Oscillations of Magnetograms during Thunderstorms at Alibag

A. S. CHAUBAL, D. K. DESHMUKH and S. L. MALURKAR, Bombay

In a previous communication (1956), the authors gave an account of oscillations set up in magnetographs which had been set up on solid pillars and on a raised platform during a severe thunderstorm (June 2 1955). Later in the year some more records were obtained and during a very severe thunderstorm, the Watson magnetographs were put on quick run. (twelve times open scale of the usual one) On sept. 19, 1955, a thunderstorm was in progress between 0745 to 0815 hrs. (I.S.T.). The Watson Horizontal magnetograph shows fine oscillations like micro pulsations while



the Vertical magnetograph recorded more prominently. The La Cour magnetographs also show the same. About 05hr. of 20th sept. the La Cour magnetographs again were disturbed at the time peels of thunder while the Watson instruments did not get affected. The same night 20th Sept. 1955 a very severe thunderstorm developed over the observatory and the Watson magnetographs were put on quick run (2250 hrs. I.S.T) for a few hours. The La Cour magnetograms showed large displacements nearly a change of  $30 \gamma$  in the  $H$  value. The Watson instruments also showed recognisable oscillations (like transient decay curves) corresponding to successive big peels and the displacement would correspond to a field of 5 to  $8 \gamma$ . The vertical magnetograph was not so much affected though quite recognisable. Taking account of the transient nature of the curve, the true displacement would correspond to a field change of not more than  $5 \gamma$  in  $H$  in the neighbourhood. In the La Cour Declination magnetograph disturbance can be seen on 20th night only.

#### 51. Geomagnetic Storms and progress of Sun spots

S. L. MALURKAR, Bombay

There is hardly any doubt that much of the variations in geomagnetic activity at a place is due to sun as a result of radiation and emission of charged and sometimes uncharged particles. The radiation part gets changed during chromospheric eruptions and the latter gets linked up with active regions of the sun and the sun spots.

It is generally assumed that within 24 to 48 hours of the passage of an active sun spot group or region across the sun's central meridian a geomagnetic storm might or would result. During the active period of sun's activity spots cross the central meridian in regular succession and it would be difficult to assign a magnetic storm with the central meridian passage of a particular group. A tabulation of the evolution at central meridian a few days before and a day after the commencement of a magnetic storm at Alibag was made for years when published data were easily available. As was to be expected a few of the prominent magnetic storms followed large spots crossing the C.M. But in the case of a larger number of magnetic storms no such inter-relation could be had. Some of the really big storms were associated with quite insignificant spots.

[The tables extend over several pages which can be projected].

There is of course no definite evidence that the passage across other meridians of the sun could be associated with magnetic storms. In a few instances, it appeared that the spots were in a degarding stage.

### VII Electromagnetic Waves and Oscillators.

#### 52. Microwave Absorption in Ethyl Chloride due to Rotational Transition

KRISHNAJI and G. P. SRIVASTAVA, Allahabad

Ethyl chloride is a slightly asymmetric top molecule having its principal moments of inertia as  $A = 30,124$  mc/sec.,  $B = 5,493.76$  mc/sec. and  $C = 4962.24$  mc/sec. Using the expression for a nearly prolate rotor, its frequency for  $J = 0 \rightarrow 1$  transition was calculated as  $10,297.5$  mc/sec. Absorption coefficient for Ethyl chloride was, therefore, measured at pressures varying from 1 cm to 50 cm of mercury at frequencies

ranging from 8,700 mc/sec. to 10,600 mc/sec. The experimental arrangement uses a 2K39 Klystron as the source of microwave power, a seven feet waveguide cell for holding the absorbing gas, a 1N23 crystal detector and other necessary waveguide components. The measurements were made at 0°C by keeping the waveguide cell in a low temperature cabinet. It has been observed that the average value of absorption coefficient at 10,300 mc/sec. is  $5.5 \times 10^{-4}$  per cm and is practically independent of pressure. At other frequencies e.g., 8,780 mc/sec. and 10,600 mc/sec., the absorption coefficient at moderately low pressure varies approximately as  $p^2$ . The Van Vleck-Weisskopf expression for the microwave absorption coefficient is

$$\frac{\alpha}{\nu^2} = \pi I_p \left[ \frac{\Delta\nu}{\Delta\nu^2 + (\nu - \nu_0)^2} + \frac{\Delta\nu}{\Delta\nu^2 + (\nu + \nu_0)^2} \right]$$

When the measurements are made at frequencies near the resonant frequency the second term is negligible as compared to first one and expression reduces to

$$\frac{\alpha}{\nu^2} = \pi I_p \left[ \frac{\Delta\nu}{\Delta\nu^2 + (\nu - \nu_0)^2} \right]$$

When measurements are made at the resonant frequency  $\nu = \nu_0$  and the expression reduces to

$$\frac{\alpha}{\nu^2} = \pi I_p \cdot \frac{1}{\Delta\nu}$$

If we can assume that  $\Delta\nu \propto p$ , the absorption coefficient is independent of pressure and this explains our observations at 10,300 mc/sec. When the frequency of measurement is not equal to the resonant frequency and the pressure is low,

$$\frac{\alpha}{\nu^2} = \pi I_p \cdot \frac{\Delta\nu}{(\nu_0 - \nu)^2} = Kp^2$$

This square law variation with pressure explains our observations at 10,600 mc/sec. and 8,780 mc/sec.

The values of  $I$  and  $\Delta\nu$  which give best fit in our observations are  $I = 1.079 \times 10^{-10}$  and  $\Delta\nu = 0.0731 \text{ cm}^{-1}$  per atoms. The value of the collision diameter as calculated from the above data at one atmosphere pressure is 6.20 Å.

The observations indicate that the absorption line is quite sharp and weak.

### 53. Effects of Phase Error on the Directivity Pattern of a 3 cm Parabolic Reflector.

SHANKER SWARUP, Allahabad

The directivity pattern and directivity gain of a microwave antenna using a parabolic reflector are dependent among other things, on the type of feed and the distance of the feed from the vertex of the parabolic reflector. This work was undertaken to study the changes on directivity of a 3 cm antenna using a parabolic reflector by placing the illuminating dipole at various distances from the vertex of the paraboloid. The changes observed in the directivity pattern are mainly due to different

amounts of phase error existing across the mouth of the reflector for different positions of the dipole.

The antenna used here has an aperture diameter 68 cm and a focal length 20.2 cm, thus having  $f/D = 0.297$ . It was fed by a dipole-disc feed at an operating wavelength of 3.2 cm. Observation was taken in the  $H$  plane by placing the feed at distances varying from  $0.74.f$  to  $0.99.f$  from the vertex of the paraboloid. It is observed that the main lobe of the directivity pattern gets bifurcated when the dipole is at distances lower than  $0.84.f$  from the vertex. The intensity of the side lobe in terms of the main lobe is minimum ( $= 13\%$ ) when the dipole is at  $0.89 f$  from the vertex. The half-width of the main lobe, however, diminishes as the feed comes nearer the focus. The theoretical pattern is calculated with the help of the expression

$$E = O. \frac{J(K\xi R)}{K\xi R} \quad (O = \text{Constant}).$$

where  $E$  is the field at a point making an angle  $\xi$  with the axis,  $K = \frac{2\pi}{\lambda}$  and  $R$  is the radius of the aperture of the parabola. It is found that the theoretical half-power width ( $2.84^\circ$ ) is closest to the case when the dipole is at  $0.89 f$  from the vertex.

Possible reasons for the differences between the theoretical and experimental patterns are discussed in the light of phase error and asymmetry of excitation.

#### 54. Microwave Field Strength and Fading behind a Ridge

RAJENDRA VIKRAM SINGH, M. N. RAO and SHINTARO UDA,  
New Delhi

Results of microwave propagation tests on 14 kilometres path in New Delhi are outlined. A pulse-time-modulation transmitter operating at 1940 Mc/sec., with 25 watts peak power, and a receiver at 1860 Mc/sec., are duplexed to a 4 ft. paraboloidal antenna on top of the National Physical Laboratory tower. Similar equipment is installed at the Central Road Research Institute. A ridge, 1.9 kilometres from NPL, protrudes a few metres above the line of sight between the antennae. A low ridge, well below the line of sight, lies 11 kilometres away.

Microwave field intensities and power supply voltage are recorded over long periods at chart speeds upto 240 mm./hour. There is some discrepancy between the estimated and observed values of field intensity, the reason for which is not definite at the present stage.

The ridge also eliminates waves reflected from the ground and substantially reduces rapid fading. No marked difference between horizontally and vertically polarized waves is observed. Rapid fluctuations of signal are identical at both terminals, as expected in propagation through reciprocal media. Slow power supply voltage variations produce occasional differences between average signal levels recorded at the terminals. The threshold value of signal for pulse-time-modulation system is also verified. Further experiments are in progress.

#### 55. Transistor Characteristics at very low temperatures

S. UDA, New Delhi

Terminal characteristics of  $p-n-p$  junction transistor at liquid air temperature have been reported by the present author in the Journal of Scientific and Industrial

Research, 1956, Vol. 1, 15B, No. 6. This is the report of further research conducted on the same lines down to the temperature of liquid helium.

Four terminal characteristics, that is, input characteristic, output characteristic, transfer characteristic, and feed back characteristic of base common  $p-n-p$  junction transistor at different temperatures, i.e., room temperature, liquid air temperature, and liquid helium temperature are compared. The current amplification factors at low temperatures are also given.

As specimen, three kinds of  $p-n-p$  junction transistor made by different companies have been tested. Generally it is observed that with the fall of temperature, larger emitter voltage is necessary to get the same emitter current. Also for the same emitter current, the lower the temperature is, the smaller is the collector current. In other words, the current amplification factor decreases with the fall of temperature. Four parameters, i.e., input resistance, output resistance, feed back resistance and transfer resistance change with the temperature.

It is also observed that at low temperatures the cut off point of the collector current in the positive direction of the collector voltage extends more towards greater positive values.

## 56. Dispersion of Microwaves in Ammonia and Deutero-ammonia

PREM SWARUP, Allahabad

Dielectric dispersion has been theoretically studied in the case of gaseous  $\text{NH}_3$  and  $\text{ND}_3$  in the microwave region. Ammonia is a symmetric top pyramidal molecule which copiously absorbs centimetre wave radiations due to its inversion in its ground vibrational state. The inversion frequency lies at  $0.78 \text{ cm}^{-1}$  which shifts to zero frequency as the pressure is increased and the resonant absorption of  $\text{NH}_3$  transfers to nonresonant or Debye absorption at 2 atmospheric pressure. The dispersion associated with the inversion line has been calculated on the basis of the quantum mechanical expressions of VanVleck and Weisskopf for the shape of the collision broadened spectral line. The final expression for the electric susceptibility of ammonia taking into account the contribution due to the electronic polarisation comes out to be :

$$\delta\nu = 0.522 \times 10^{-4} \cdot p + 0.14 \times 10^{-3} \cdot p \left[ \frac{\Delta\nu^2 + \nu_0(\nu + \nu_0)}{\Delta\nu^2 + (\nu + \nu_0)^2} + \frac{\Delta\nu^2 - \nu_0(\nu - \nu_0)}{\Delta\nu^2 + (\nu - \nu_0)^2} \right]$$

where  $\nu$  is the frequency of measurement,  $\nu_0$  the resonant frequency,  $\Delta\nu$  the line width parameter and  $p$  the pressure in cm Hg. Dispersion curves have been plotted at various pressures in a wide frequency band. It has been found that the electric susceptibility varies linearly with pressure at frequencies far from resonance and the graph shows concavity towards pressure axis just before resonance and convexity after resonance. The experimental points taken at  $0.3 \text{ cm}^{-1}$  coincide with the theoretical curve.

The case has been extended to Deutero-ammonia, where the inversion frequency lies 15 times lower due to its greater reduced mass. The inversion frequency shifts from  $0.052 \text{ cm}^{-1}$  to zero frequency at 9 cm pressure. The dispersion curve is very sharp at 1 cm pressure but at higher pressures as the line width parameter becomes of the order of the frequency, the maximum and minimum points disappear. The pressure variation graph shows concavity towards pressure axis at  $0.04 \text{ cm}^{-1}$  (before

resonance) and convexity at  $0.06 \text{ cm}^{-1}$  (after resonance). The final expression for the calculation of the electric susceptibility is :

$$\delta\nu = 0.0658 \times 10^{-3} \cdot p + 1.43 \times 10^{-5} \cdot p \left[ \frac{\Delta\nu^2 + \nu_0(\nu + \nu_0)}{\Delta\nu^2 + (\nu + \nu_0)^2} + \frac{\Delta\nu^2 - \nu_0(\nu - \nu_0)}{\Delta\nu^2 + (\nu - \nu_0)^2} \right] .$$

### 57. Shaped Electrode Analysis (I) : Ordinary and Modified Guard Ring Electrodes

AMALENDU ROY, Kharagpur

The possibilities of shaped electrodes in sending currents into the ground in any chosen direction are discussed from the point of view of mineral exploration. The Guard Ring Electrode (a circular plate surrounded by an annular guard and both kept at the same potential) and some of its modifications have been treated theoretically and experimentally. For any practical size of these electrodes, the depth of penetration or the range of focussing appear to be too small to be useful in prospecting. Some suggestions have been put forward along which further work will be done in an attempt to increase the depth range.

### 58. Improved System of Pulse Height Analysis from Records of Oscilloscope display

SM. S. CHAUDHURY and B. M. BANERJEE, Calcutta

In this system, input pulses are stretched and applied to the Y-plates of the display oscilloscope. This produces a spot display as the beam is switched only for the stretch duration. The spots represent pulses whose Y-positions give the amplitude. Records are made on a continuous motion camera that gives the basis X-movement. To prevent overlapping auxiliary X-movements are also produced by voltage obtained from a "diode pump circuit". This produces, momentary forward movements that separate subsequent pulses from the previous ones, even when they follow each other with time-separations measured in microseconds. By adjusting the leakage of the storage condenser in the diode pump circuit, the average recession rate could be made slightly smaller than the film winding rate. Then even for pulse pairs having long time separations, the spot positions on the film would be adjacent. Pulses could thus be packed closely, (upto about 400 per inch) without overlapping, by selecting suitable winding speeds and leakage resistors. Such records are not only economical, but leads to easier and more accurate analysis.

### 59. Equipment and Procedures for Optimum adjustment of the Delay lines in Distributed Amplifiers

S. C. NATH and B. M. BANERJEE, Calcutta

Optimum performance of distributed amplifiers require that individual sections of grid and plate lines be adjusted (a) to the proper impedance and (b) for equal delays. Electrode capacitances form the main capacitive element of these lines. Their values vary from tube to tube. As a result, construction cannot depend upon calculation, but must be optimized by a test system that is described in this paper. It consists of a pulse generator that delivers three pulses, a fast oscilloscope, the distributed amplifier under test and a probing amplifier. The first pulse triggers the oscilloscope sweep, the second pulse acts as a reference mark and the third pulse excites the grid lines of the distributed amplifier. Delays in individual sections are matched by noting

the position of the pulse probed at the plate line output, as the screens of the different tubes are switched, one after another. The shape positions and amplitudes of the pulses show the impedance mismatch. These may be verified by deliberate introduction of irregularities at suspected points. The grid line is probed similarly.

## VIII. Cosmic Rays.

### 60. Nuclear Size from Cosmic-ray interactions

M. S. SINHA and N. C. DAS, Calcutta

The total path length of 3625 penetrating charged secondaries of average energy 4 Bev has been measured in three plate assemblies of Al, Cu and Pb inside a big square cloud chamber. The total number of nuclear interactions observed were divided into two groups of (i) nuclear disintegrations (high energy transfers) and (ii) nuclear scatterings and the *total* cross-section and the cross-section for nuclear disintegrations alone have been determined. It has been found that the equivalent square well radii of Al, Cu and Pb found from the latter cross-sections agree well with  $1.19 \times A^{\frac{1}{3}} \times 10^{-13}$  cm whereas the radii corresponding to the total cross-section follow  $1.34 \times A^{\frac{1}{3}} \times 10^{-13}$  cm. The results thus indicate the same matter distribution in Al, Cu and Pb nuclei as that determined from high energy electron scattering, mu-mesonie X-ray data and high energy neutron absorption data. Moreover each nucleus appears to be surrounded by an equivalent spherical shell of thickness  $0.15 \times A^{\frac{1}{3}} \times 10^{-13}$  cm. which chiefly accounts for the nuclear scatterings. The existence of this shell is presumably the effect of the finite range of nuclear forces.

### 61. Mean free path for Trident Process at High Energies

PREM KUMAR, Punjab

A study of electromagnetic cascades initiated by photons or electrons of primary energy greater than  $2 \times 10^{10}$  V., has been carried out in nuclear emulsions exposed in the stratosphere at geomagnetic latitude  $19^\circ$ . Fifteen electron-photon showers, 8 initiated presumably by a single photon, 4 by a single electron and three occurring in the core of a "jet", produced by a proton of energy  $> 10^{13}$  eV., have been employed. Using the "along the track following" method, 125 pairs and 49 possible tridents were obtained in a track length of 3.83 meters of emulsion, for electrons of energy  $10^9$  to  $10^{11}$  eV. Opening angle measurements on pair tracks have been related to the photon energy by taking into account the contribution due to multiple Coulomb scattering. After correcting for the spurious tridents arising on account of the chance materialisation of bremsstrahlung photons on electron tracks, the mean free path for the trident process has been determined as :

$$6.1^{+2.6}_{-1.4} \text{ for } 1 \text{ BeV., to } 10 \text{ BeV., and}$$

$$4.0^{+1.4}_{-0.8} \text{ for } 10 \text{ BeV., to } 100 \text{ BeV.,}$$

measured in units of cascade length, 3.0 cm., of nuclear emulsion. Subject to the limitations of the technique, the experimental results are compared with the theoretically predicted values of Bhabha.

## 62. Construction and performance of plastic stratosphere balloons

G. S. GOKHALE, U. V. GOPAL RAO, P. J. LAVAKARE, M. G. K. MENON,  
B. PETERS and R. T. REDKAR, Bombay

Balloons with a capacity of 15000 to 19000 m<sup>3</sup> have been constructed using Polyethylene sheets of 37 micron thickness. Such balloons should carry experimental equipment weighing upto 60 kg. to altitudes corresponding to 9 to 12 g/cm<sup>2</sup> of residual atmospheric pressure.

The method of construction and the flight performance of these balloons will be discussed.

63. Abundance of Li, Be, B Nuclei in the primary cosmic radiation at  $\lambda = 41^\circ$ 

M. V. K. APPA RAO, S. BISWAS, R. R. DANIEL, P. C. MATHUR,  
K. A. NEELAKANTAN and P. KUMAR,\* Bombay

An accurate knowledge of the relative proportion of the light group of nuclei (Li, Be, B) as compared to the medium group (C, N, O, F) in the primary Cosmic Radiation will permit one to obtain information regarding the origin and mode of acceleration of Cosmic-Ray particles. This problem has been investigated in the present experiment using a stack of emulsions flown at 114,000 ft. for 6 hours at geomagnetic latitude  $41^\circ\text{N}$ . The emulsions were under-developed to various degrees so that it was possible to identify individual nuclei uniquely by grain counting. The results and its implications are discussed.

\* On leave from Punjab University, Hoshiarpur.

64. The Flux of  $\alpha$ -particles, Li, Be, B and heavier nuclei in the primary cosmic radiation at Geomagnetic Latitude  $3^\circ\text{N}$ 

V. K. BALASUBRAMANIAM, S. BISWAS, G. S. GOKHALE and P. C. MATHUR)  
Bombay

Measurements on the flux of  $\alpha$ -particles and heavier nuclei in the primary cosmic radiation at geomagnetic latitude  $3^\circ\text{N}$  by two methods will be discussed :

One method uses a cosmic-ray telescope containing a thin plastic scintillator and a Cerenkov radiator as well as a tray of G.M.-counters. For each event the pulse heights in the scintillator and the Cerenkov counter are displayed on the screen of an oscilloscope and photographed on a continuously moving film. They are analysed by a comparison with pulses produced by singly-charged relativistic particles on the ground. Multiply charged relativistic particles will yield the same ratio of scintillator to Cerenkov pulse heights, as the particles observed on the ground, only the magnitude of the pulses will be larger by a factor  $Z^2$  where  $Z$  is the atomic number of the primary particle. Pulses due to showers and to nuclear disintegrations produced in the apparatus can be recognized by the fact that the ratio of scintillation to Cerenkov pulse heights will be quite different from that produced by single particles.

In the second experiment sheets of unbacked nuclear emulsions are used. The  $\alpha$ -particles and the heavier groups of nuclei are identified by grain-density and delta-ray

density measurements respectively. A slight motion of emulsion sheets with respect to each other after the balloon has reached altitude, permits to distinguish particles incident at the top of the atmosphere from those which arrive during the ascent of the balloon.

#### 65. Multiple Scattering Measurements on high energy protons

S. BISWAS, N. DURGA PRASAD and (MRS.) S. MITRA, Bombay

Multiple Scattering measurements have been carried out in emulsions exposed to the proton beam from the Berkoley Bevatron. About 70 flat tracks of mean length 30 mm. per plate of 600 $\mu$  thickness have been measured with basic cell length of 1000 $\mu$ . The relative scattering measurements on tracks separated by less than 50 $\mu$  yield the mean energy of the proton beam as  $5.2 \pm 0.3$  Bev. based on a scattering constant  $K = 27.2$  for 1000 $\mu$  cells. The reliability of the relative scattering measurements has been checked by measurements on tracks of multiply charged fragments arising from the break up of heavy primary particles whose energy exceeds 5 Bev/nucleon.

The mean values of Spurious Scattering in this stack have been obtained with cell lengths of 1000, 2000, 4000 and 8000 $\mu$  and found to be smaller than those previously obtained by Biswas, Peters and Rama and by other investigators in other emulsions. The variation of Spurious Scattering with cell length is found to vary as  $l^{0.8 \pm 0.1}$ .

Additional measurements on 5.7 Bev Protons in another stack and the variation of Scattering Constant with cell length for cell sizes 1000 $\mu$  to 4000 $\mu$  will be discussed.

#### 66. On Cosmic-ray Produced Radioactivity in the Atmosphere

P. S. GOEL, D. P. KHARKAR, D. LAL, N. NARSAPPAYA, RAMA and  
P. K. ZUTSHI,\* Bombay

The partial destruction of Nitrogen, Oxygen and Argon nuclei in the atmosphere by the cosmic radiation leads to the production, at a constant rate, of a variety of unstable nuclear fragments.

So far six radio-nuclides,  $H^3$ ,  $Be^7$ ,  $Be^{10}$ ,  $C^{14}$ ,  $P^{32}$  and  $P^{33}$  have been detected. The first four are primarily produced in nuclear interactions with nitrogen and oxygen nuclei, while  $P^{32}$  and  $P^{33}$  arise in the spallation of Argon. The half lives of these Cosmic Ray produced activities range from 2 weeks to 2.7 Million Years.

The general problems associated with their production, detection and applications will be discussed. Theoretical considerations indicate that apart from  $P^{32}$  and  $P^{33}$  the spallation of atmospheric argon leads to other radioactive products which can be isolated in the air and in precipitation.

\* On study leave from Victoria College, Gwalior, Madhya Pradesh.

#### 67. The Annual Deposition of Radioactive Beryllium<sup>7</sup>.

RAMA and P. K. ZUTSHI,\* Bombay

Rainwater from Kodai-kanal has been analysed for its  $Be^7$  content for the period 31st January, 1956 to the end of August, 1956. Similar analyses were carried out for rains at Bombay and Benares, during the monsoon period of 1956.

\* On study leave from Victoria College, Gwalior, Madhya Pradesh.



The  $\text{Be}^7$  contents in individual rains vary from 400 to 10,000 atoms per c.c. of rainwater and seem to be correlated with various meteorological factors.

Observations on  $\text{Be}^7$  contents of rain, snow or air may be developed into a useful meteorological technique.

#### 68. The Concentration of Cosmic-ray produced Radioactive Phosphorous Isotopes $\text{P}^{32}$ and $\text{P}^{33}$ in Rain-water

D. LAL, N. NARASAPPAYA and P. K. ZUTSHI,\* Bombay

In addition to the isotope  $\text{P}^{32}$  (half-life 14.3 days) detected by Marquez and I'Costa, we have now found the second isotope of Phosphorous  $\text{P}^{33}$  (half-life 25 days) in rain-water.

Measurements on the absolute concentrations on  $\text{P}^{32}$  and  $\text{P}^{33}$  nuclei in rain-water samples collected from Bombay and Kodai-kanal are described.

Because of their identical chemical behaviour the two phosphorous isotopes which are produced at a constant rate in the atmosphere should prove very valuable in the meteorological studies.

\* On study leave from Victoria College, Gwalior, Madhya Pradesh.

#### 69. The Cosmic-ray produced $\text{Be}^{10}$ Isotope

P. S. GOEL, G. P. KHARKAR, D. LAL, N. NARASAPPAYA and V. YATIRAJAM,\*  
Bombay

An attempt has been made to isolate and identify the predicted  $\text{Be}^{10}$  activity of deep-sea sediments in cores obtained from the floor of the Pacific Ocean.

Procedure and results are described.

\* Now at the National Metallurgical Laboratory, Jamshedpur.

#### 70. Cosmic-ray produced $\text{S}^{35}$ Isotope in Rainwater

P. S. GOEL, Bombay

Experiments are described to isolate and identify the Cosmic-Ray produced radioactive isotope  $\text{S}^{35}$  in rainwater collected at various locations.

Results and methods will be presented.

### IX. Nuclear Reactions.

#### 71. On the elastic scattering of charged particles by heavy nuclei

S. N. GHOSHAL and B. B. BALIGA, Calcutta

An expression has been obtained for the differential cross section for the elastic scattering of intermediate energy charged particles by heavy nuclei, using a complex potential and employing the variational method due to Montroll and Greenberg<sup>1</sup>. It is based on an approximation method due to Hart and Montroll<sup>2</sup> for solving the

problem of scattering of plane waves by scatterers having sharp boundaries. Montroll and Greenberg have extended this method to the case of scatterers which do not have sharp boundaries by using variational principles. They have considered the case of real potential wells. In the present work the method has been extended to the case of a complex potential well. The potential considered is of the type  $V = (V_0 + iW_0)$  inside the nucleus and  $Ze^2/r$  outside. The method is applicable for an absorbing sphere whose complex index of refraction is less than 1.5.

The expression obtained for the differential elastic scattering cross section has been used in the case of scattering of 32 Mev protons from gold. It has been shown that the present method of calculation gives results which are in agreement with those obtained by using the partial wave method.

The calculated cross sections have been compared with the experimentally determined cross sections for the scattering of 32 Mev protons from gold. The agreement is not good as might be expected since it is well known that with the square well type complex potential used back reflection enhances the calculated cross-sections substantially. Work is in progress using a complex potential with diffused boundary inside the nucleus.

1. Montroll and Greenberg, *Phys. Rev.* **86**, 889, (1952).
2. Hart and Montroll, *Journ. Appl. Phys.*, **22**, 376, (1951).

## 72. Cerenkov Effect in Double Media

A. M. SAYED, Calcutta

The Cerenkov radiation emitted by a swiftly moving charged particle moving through one medium and in the vicinity of another medium has been theoretically investigated. Two simple geometries have been considered. One being the case of two co-axial dielectric and permeable cylinders with the charged particle moving along their common axis. The other being the case of two media with an infinitely extended plane interface and the charged particle moving with a uniform velocity parallel to the interface and very close to it through one of the media. The results obtained will be discussed with special reference to the case of Cerenkov radiation at microwave and radio-frequency regions. Remarks will be made about the phenomena of coherence in such cases.

## 73. On Certain Aspects of Cerenkov Radiation Phenomena

A. M. SAYED and B. D. NAG, Calcutta

The effect of the phenomena of coherence on the nature of Cerenkov radiation emitted by a group of charged particles all passing together through the same media, has been investigated. The nature of the radiation is found to depend on the description of the group charges in addition to the usual dependence of the nature of the Cerenkov radiation on the charge, its velocity and the media. The importance of the effect in making feasible the detection of Cerenkov type of effect in strongly permeable media will be discussed and results stated.

74. *Bremstrahlung* from electron-electron Scattering

T. C. Roy, Calcutta

In this paper we have considered the case of scattering of electron by electron with simultaneous production of photon. The differential cross-section is obtained from matrix element in the  $e^3$  approximation. The calculation is made from the lowest order nonvanishing matrix element occurring in the Dyson-expansion of the  $S$  matrix. Further simplifications are obtained using Feynman diagrams and thus working in the momentum space. The final result is lengthy and for its expression the text may be consulted.

## 75. Determination of thermal neutron scattering cross-section of hydrogenous liquids

N. K. GANGULI and A. M. GHOSE, Calcutta

An experimental arrangement has been set up to determine the scattering cross-section of hydrogenous liquids for thermal neutrons. A large howitzer has been designed and constructed in the laboratory to provide a well-collimated thermal neutron beam. The angular half-intensity width of the beam is only a few degrees. The beam emerging from the howitzer is further collimated by cadmium and boron oxide filters. The absorber holders are made of dural to avoid extraneous scattering. The detector employed is a photomultiplier. The phosphor, which has been prepared in the laboratory, is a mixture of Zn-S Ag powder with boric acid powder of optimum grain size. The apparatus has been calibrated by water, the scattering cross-section of which is well-known. The object of this experiment is to correlate the molecular configuration, association, hindered rotation of intra-molecular groups etc., using the mass-tensor approximation of Teller and Sachs together with the theory of hindered rotation as developed by Kobos.

## 76. Motion of a spinning charged particle in the field of a magnetic pole

Miss D. Roy, Calcutta

In this paper we have considered the motion of a spinning charged particle having spin  $f\hbar$  and charge  $e$  in the field of a magnetic pole. Like the cases of Dirac and Harishchandra it is found that no bound state of the system exists.

This seems to suggest that spin is not the factor for the existence of bound states in such a case. Situations are studied in nonrelativistic approximation as relativity does not alter the nature of the solution which can easily be shown to be the case in considering simpler type of motion in the field of a magnetic pole.

## 77. An explicit expression for the density of emergent neutrons of the Milne-Problem in neutron-diffusion without capture

SANTI RANJAN DAS GUPTA, Calcutta

Here is given a simple explicit form of the angular distribution of neutrons emerging out of a semi-infinite parallel plane slab of material having sources of neutrons

uniformly distributed throughout, the capture of neutrons being ignored. The solution is expressed in terms of the explicit form of  $H(\mu)$  giving the limb-darkening for the conservative gray scattering (writer's Note, Science & Culture, Vol. 22, No. 3, 1956, Sept., p. 177). The numerical value of the asymptotic form of neutron density deduced from the above-mentioned solution agrees with the one given by Marshak (R. E. Marshak, Physical Review, 72, 47, 1947) defining

$I(\tau, \mu) d\mu$  = no. of neutrons per unit volume at the depth  $\tau$  with direction-cosines between  $\mu$  &  $\mu + d\mu$

$2p_0$  = no. of neutrons produced per unit volume assumed constant.

$\frac{x}{3}$  = measure of the deviation of the scattering function from isotropy.

The relevant equation is

$$\mu \frac{dI}{d\tau} = I - \frac{1}{2} \int_{-1}^1 I(\tau, \mu) d\mu - x \mu \cdot \frac{1}{2} \int_{-1}^1 I(\tau, \mu) \cdot \mu d\mu - p_0$$

The distribution function for the neutrons emerging out of the surface  $\tau=0$  is given by

$$I(0, \mu) = H(\mu) \left[ \frac{a_2}{a_1} + d - \mu \right] \sqrt{3} p_0$$

and the asymptotic neutron density by

$$J(\tau) \text{ a symp. } \sim -\frac{3}{2} p_0 \tau^2 + 3p_0 d \left[ \tau + \frac{a_2}{a_1} + \frac{15 \left[ \frac{a_2}{a_1} \right]^2 - 1}{30d} \right]$$

where  $J(\tau) = \frac{1}{2} \int_{-1}^1 I \cdot d\mu$ ,  $2d$  = thickness of the Slab

$a_2, a_1$  are the moments of  $H(\mu)$ ,  $\frac{a_2}{a_1} = \frac{0.820352}{2/\sqrt{3}} = 0.710464$ .

$$H(\mu) \equiv \frac{\exp \left\{ \sum_{r=1}^{m-1} q_r (-\mu)^r + \sum_{r=1}^m a_r (-\mu)^{r-1} \ln \frac{\mu+1}{\mu} \right\}}{1 - \mu \ln \frac{\mu+1}{\mu}} \rightarrow 1 \text{ as } \mu \rightarrow 0+$$

78. Resonant states in  $\pi-\pi$  Scattering

A. N. MITRA and R. P. SAXENA, Aligarh

The theoretical importance of  $\pi-\pi$  interaction stems from its role in influencing the behaviour of meson nucleon scattering. This is most easily visualized by noting that a nucleon is surrounded by its own meson cloud which the incident meson beam (falling on the target) has to encounter. This picture provides a natural phenomenon of scattering of mesons by mesons. Now it can be safely assumed that the  $\pi-\pi$  interaction has a much shorter range than the  $\pi-p$  interaction, so that the meson cloud around the nucleon can almost be regarded as free so far as the incident meson beam is concerned. Though such  $\pi-\pi$  interactions have been previously postulated in a phenomenological manner, a theoretical treatment based on the pseudo-scalar theory is obviously desirable.

The superiority of the Tamn-Dancoff approximation over the usual perturbation theory in explaining low energy  $\pi-p$  scattering phenomena has encouraged us to study the  $\pi-\pi$  problem from this point of view. The Tamn-Dancoff integral equation for  $\pi-\pi$  scattering has been set up and analysed into states of different relative angular momenta ( $l$ ) and total isotopic spins ( $I$ ). The equations have been solved for the two cases  $l=0, I=0$ ;  $l=0, I=2$ . It is found that the interaction in the latter state is resonant at the C.M. momentum  $\sim \frac{100 \text{ Mev}}{c}$  of each meson, with the standard value 15.5 for the coupling constant. This resonance plays a significant role in influencing the  $\pi-p$  scattering in the state of total isotopic  $T=3/2$  but not  $T=1/2$ .

## 79. Measurement of Recovery-time of G. M. Counters. Method—II

G. C. JAIN and R. PARSHAD, New Delhi

Amplified G. M. triggers feed a scaling circuit and delay-generator. Delayed triggers are fed back to the trigger-amplifier, with the polarity reversed, so that they (delayed triggers) tend to nullify the effect of G. M. triggers applied to the amplifier at the instants when delayed triggers are applied. As long as the delay is less than the least time-spacing between G. M. triggers, the trigger-count as observed on the scaler remains constant. For delay-times greater than the least time-spacing between G. M. triggers, the count decreases.

The full recovery time of G. M. Counter is measured by making the delay generator and the scaler sensitive only to the largest triggers from the G. M. Counters. Partial recovery-time can be measured easily by making the delay generator and the scaler sensitive to triggers of a known percentage of the strongest G. M. triggers. The dead time of G. M. Counters can be measured by extrapolation.

## 80. Measurement of Recovery-time of G. M. Counters. Method—I

G. C. JAIN and R. PARSHAD, New Delhi

G. M. pulses are applied to a monostable multivibrator the time-duration of the unstable state of which can be varied. The output of the multivibrator is differentiated

to yield triggers for a scaling circuit. Use is made of the fact that as long as the multivibrator is passing through its unstable state, it remains insensitive to any triggers applied to it, which tend to put it in its unstable state. Disregarding the dead-time of the multivibrator, it follows from the above, that as long as the time-durations of the square-waves from the multivibrator are less than the least spacing between the G. M. triggers, the frequency of occurrence of square-waves of the multivibrators will remain constant. Due to this fact, the recovery-time of the G. M. counter can be measured. Due to the fact that the multivibrator has its own dead-time, the limit of constancy of frequency of the square-waves is reached when the sum of duration of each square-wave and the dead-time of the multivibrator is equal to the least spacing between G. M. pulses. Dead-time of the multivibrator is measured by feeding the multivibrator with variable frequency trigger source. The trigger frequency is increased from lower limits, till every other trigger fails to fire the multivibrator.

Full recovery-time of the G. M. counter is measured by making the multivibrator sensitive only to the strongest triggers from the G. M. counter.

### 81. Determination of Mean life of Thermal Neutrons in water

N. K. SAHA and K. L. KAILA, Delhi

By observing the average activity induced by thermalised neutrons from a 100 mgm Ra  $\alpha$  + Be-source in a dil. aqueous solution of potassium permanganate in a large container and noting its change on the addition of a small amount ( $\sim 5.65$  mg/c.c.) of boric acid to the solution, the mean life  $\tau$  of thermal neutron capture in water is determined. The value is corrected for neutron-leakage through the container surface and capture of slow neutrons by the Mn-nuclei. The final result obtained is  $\tau_0 = 248 \pm 20 \mu \text{sec}$ . This value is considered in the light of the values derived from the measurements of the neutron diffusion length and found to be reasonably good.

### 82. Elastic Scattering of 32 Mev protons from gold

S. N. GHOSHAL and B. B. BALIGA, Calcutta

The results of an experiment on the elastic scattering of 32 Mev protons from the Berkeley linear accelerator by gold, which had been performed several years ago, are reported. A preliminary report of the work has been communicated earlier<sup>1</sup>. The photographic plates which had been employed for the detection of the scattered protons have been re-scanned systematically. The differential scattering cross section have been plotted as a function of the scattering angle. These include contributions of the inelastic scattering of protons from several low lying levels in Au<sup>197</sup>. To estimate this effect, the differential distribution of the ranges of the scattered protons in the photographic emulsion has been determined. From this range distribution curve, the upper limit of the differential elastic scattering cross section at various scattering angles has been estimated.

1. Ghoshal S. N., *Proc. 39th Ind. Sc. Congress Assoc.* (1952)

**83. A New Approach to Nuclear Structure****Y. G. NAIK, Ahmedabad**

A new approach to the structure of the nucleus is attempted. It gives a fairly satisfactory explanation about nuclear shell structure as well as other questions of stability etc. It is based on the hypothesis that  $n$ th. element in the periodic table contains  $n$  particles inside the nucleus. Such a picture can be built up by assuming that the nucleus is made up of three types of fundamental nuclei viz., hydrogen, deuterium and tritium. A complete scheme of stable and unstable nuclei is evolved and it gives a better understanding of several important properties like isomerism, nuclear shell structure, abundance of isotopes, radioactivity, artificial radioactivity etc.

## SECTION OF CHEMISTRY

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*Abstracts.*

### INORGANIC CHEMISTRY

#### 1. Spectrophotometric Studies on the Formation and Decomposition of Copper biguanide chelate.

MANOJ M. RAY AND PRIYADARANJAN RAY, Calcutta.

The successive formation constants and the overall instability constants of copper biguanide chelate have been determined from a photometric study of its formation from cupric ion and biguanide. Absorption spectra of the successive complexes have been measured. Copper monobiguanide has an absorption maximum at 660 m $\mu$  and copper bisbiguanide at 520 m $\mu$ . Variation of the absorption spectra with pH shows the predominance of copper monobiguanide in the pH range 3.4-5.4 and that of copper bisbiguanide above pH 5.4. From the optical density of solutions at optimum pH values and at constant ionic strength, containing biguanide in excess over the stoichiometric ratio of the complexes, quantitative figures for the extinction coefficients of the complexes have been derived.

There are two distinct equilibria, one between copper ion or hydrated copper ion and copper monobiguanide or its hydrate and the other between copper monobiguanide and copper bisbiguanide; simultaneous occurrence of more than two successive components in equilibrium is, however, excluded. Since in the system under study of the two absorbing entities, one has appreciable extinction at the absorption maximum of the other and vice versa, a simplified method has been developed for determining the concentrations of the complexes from the optical density measurements on mixture. The results compare well with those obtained by the standard method of solving simultaneous equations.

Absorbing Entity	Molar Extinction Coefficients (in water at 30° ± 2°)		
Copper monobiguanide	...	...	... 36.0 (660 m $\mu$ )
Copper monobiguanide	...	...	... 9.0 (520 m $\mu$ )
Copper bisbiguanide	...	...	... 38.5 (520 m $\mu$ )

The average value for the formation constant of copper monobiguanide is  $0.0124 \times 10^{12}$  with a range  $0.011-0.015 \times 10^{12}$  and the same for copper bisbiguanide is  $0.19 \times 10^9$  at 30° ± 2° at an ionic strength of 0.5 M. The overall formation constant is, therefore, given by  $2.28 \times 10^{18}$ .

The instability constants of the complexes have been determined photometrically in a similar manner from their decomposition in solution. The method adopted consisted in treating the pure complex chloride with varying amounts of acid. From measurement of pH values and absorption spectra of the equilibrium solutions, the successive decomposition constants have been calculated. The average value for copper bisbiguanide is  $2.05 \times 10^8$  and that for copper monobiguanide is  $2.68 \times 10^8$  at an ionic strength of 0.5 M at 30° ± 2°. The successive instability constants calculated from these values of the decomposition constants



and the acid dissociation constants of biguanide are  $6.2 \times 10^{-9}$  and  $8.1 \times 10^{-11}$  respectively. The overall instability constant is  $5.01 \times 10^{-19}$ , a value which is quite relevant with that calculated from the formation constant of the complex i.e.  $4.25 \times 10^{-19}$ .

## 2. Spectrophotometric Studies on the Stability of Nickel biguanide Chelate.

MANOJ M. RAY AND PRIYADARANJAN RAY, Calcutta.

Studies on the variation of the absorption spectra of nickel biguanide system with pH conclusively show that only one complex species i.e. nickel bisbiguanide is present in solution within the pH range 5.0-8.4. Thus Bjerrum's assumption that chelation takes place in a stepwise manner, though theoretically a sound one, cannot be verified in all cases. The instability constant of nickel bisbiguanide chelate has been determined photometrically, assuming that its decomposition or formation is a stepwise reaction. The absorption maximum of nickel biguanide chelate is at 460 m $\mu$ , characteristic of diamagnetic nickel complexes. The extinction coefficient of the complex has been calculated from the maximum optical density of solutions containing nickel ion and excess biguanide, assuming that the formation of the chelate is complete. This occurs for the range of pH 8.0-8.4. The average value of the overall decomposition constant calculated from the optical densities at 460 m $\mu$ , of equilibrium solutions resulting from the decomposition of pure chelate with acid, is  $4.27 \times 10^6$  at an ionic strength of 0.5 M at  $30^\circ \pm 2^\circ$ . The overall instability constant is  $3.89 \times 10^{-14}$  which is more or less in accord with the overall stability constant  $0.29 \times 10^{-14}$  determined from the studies on the formation of the complex at an ionic strength of 0.5 M at  $30^\circ \pm 2^\circ$ .

## 3. A Spectrophotometric Study of Lead-Alizarin Sulphonate Complex.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

Alizarin Red S has been observed to produce a brownish orange colour with lead salts. The colour has been found to be extremely sensitive even in the case of dilute solutions. The formation of complex has been studied spectrophotometrically using Unicam S.P. 500 spectrophotometer. The complex has a maximum absorption at a wavelength of 490 m $\mu$ .

It was found that the optical density at 490 m $\mu$  is directly proportional to the concentration of lead present showing the validity of the Beer's law in this case. Thus the reagent can be utilized for the colorimetric estimation of lead.

The composition of the coloured complex was studied using Job's method of continuous variation and the maximum change in optical density was observed when the ratio of the reactants was 1:1. Thus it is concluded that the complex is formed between one part each of lead and the dye. The effect of pH has also been studied.

## 4. A Spectrophotometric Study of Copper-alizarin Sulphonate Complex.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

The formation of a coloured complex between sodium alizarin sulphonate and bivalent copper has been reported. The complex has been studied using Unicam S.P. 500 spectrophotometer and it has been found that the complex shows maximum absorption in the spectral region of 500 m $\mu$ . The intensity of the colour is directly proportional to the amount of the copper present i.e. Beer's

law is obeyed. Thus it may be used for the colorimetric determination of the copper.

The composition of the complex has been determined using Job's method of continuous variation at various concentration and has been found to be in the ratio of 1:1 of the reactants. The effect of pH has also been investigated.

#### 5. Spectrophotometric Study of Uranyl-aurin Tricarboxylate Complex.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

Ammonium Aurin Tricarboxylate is usually used as a colorimetric reagent for aluminium and recently (1956) we have reported that the compound yields coloured complexes with several metallic ions, including uranium. In this paper we have investigated the formation of red coloured uranyl-aurin tricarboxylate complex with the help of Unicam S.P. 500 spectrophotometer.

It has been found that the complex has a maximum absorption at 540 m $\mu$ . The composition of the complex was studied at this wavelength using Job's method of continuous variation. Several concentrations of the reactants were employed and the peak in the composition-optical density curve occurred at the ratio of 1:1 of uranyl-ammonium aurin tricarboxylate. Thus the composition of the complex has been established to be 1:1.

#### 6. Spectrophotometric Study of Uranyl Acetylacetonate.

A. K. SUNDARAM and M. SUNDARISAN, Bombay.

A spectrophotometric study of uranyl-acetylacetonate system has been made. At pH 6, the compositions of the complex has been found to be  $UO_2R_2$ , where R represents the organic-radical. This method has been adopted for the estimation of uranium and is advantageous in that it is more sensitive than the usual thiocyanate and peroxide methods.

#### 7. Study of the Thorium-Gallic Acid Compounds precipitated from Aqueous Solutions.

CH. VENKATESWARLU and V. T. ATHAVALE, Bombay.

The thorium-gallic acid compound, precipitated quantitatively at pH 3.0 to 4.5, was investigated by estimating the unreacted gallic acid colorimetrically. The composition of the compound was found to be 1:1, which varied with variation of experimental conditions due to absorption of free gallic acid. An indirect colorimetric method was developed for the estimation of thorium in the range of 0.26 to 2.6 mg of thoria in 50 ml.

#### 8. Study of the Complex Formation between Beryllium Sulphate and Ammonium Aurin Tricarboxylate by the Spectrophotometric Method.

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

In an attempt to find further applications of ammonium aurin tricarboxylate as a colorimetric reagent we observed (1956) that beryllium produces a red coloured complex having a maximum absorption at a spectral region of 530 m $\mu$ . We have adopted the spectrophotometric method for the investigation of coloured beryllium-aurin tricarboxylate complex using Unicam S.P. 500 model spectrophotometer.

Different mixtures containing varying quantities of beryllium sulphate and ammonium anrin tricarboxylate were prepared following Job's method of continuous variation. The optical densities of the solutions were measured at 530 m $\mu$ , and plotted against composition. It has been concluded from the graphs that only one complex is formed at a ratio of 1:1 of the reactants.

#### 9. Polarographic behaviour of Chromium E.D.T.A. Complexes.

R. S. SUBRAHMANYA, Bangalore.

The polarograms of chromium in presence of potassium sulphate as the base electrolyte, consist of two waves corresponding to the reaction of  $\text{Cr}^{+++} \rightarrow \text{Cr}^{++} \rightarrow \text{Cr}$ . The ratio of the heights of the first to the second wave however is not as 1:2. In a mixture, if the wave of another cation coincides with the first wave of chromium it would not be possible to compute the contribution to the total wave height from the measurement of the second wave-step. This work has been undertaken to explore the possibilities of employing E.D.T.A. to overcome such difficulties and also to get an idea of the nature of the complexes produced. It has been noticed that freshly mixed solutions of the disodium salt of E.D.T.A. and chromium are colourless but on standing turn pink. It is surprising that the polarograms of the colourless and pink solutions, containing equimolecular proportion of chromium and the disodium salt of E.D.T.A. are identical. Two waves are noticed in both the cases. Addition of NaOH causes slight precipitation in the colourless solution and no precipitation with the coloured solution. Addition of sodium hydroxide is advantageous in getting very good blanks till the final current rise. It has been noticed that when the concentration of the complexing agent is increased beyond twice that of chromium, only one well defined wave of  $\text{Cr}^{+++} \rightarrow \text{Cr}^{++}$  is observed.

#### 10. Studies of the Polarographic behaviour of Uranium Complexes.

C. S. RAMANATHAN and R. S. SUBRAHMANYA, Bangalore.

Investigations on the polarographic behaviour of uranium complexes using citric acid, tartaric acid and ethanalamines as complexing agents have been carried out. Potassium perchlorate which does not form a complex with uranium was employed as the supporting electrolyte. In presence of this indifferent electrolyte, uranyl ion exhibited two waves ( $E_{1/2} = 0.21\text{V}$  and  $0.88\text{V}$  vs. S.C.H.), the height of the second wave being  $1\frac{1}{2}$  times that of the first. On addition of lithium chloride,  $E_{1/2}$  of the first wave was unaffected while that of the second wave was shifted by  $0.3\text{V}$  towards the negative side indicating complexation. In citric acid solutions, a single wave corresponding to +6 to +5 reduction state was noticed while the second wave was masked by buffer. Results obtained with tartaric acid were analogous to that of citric acid. In both cases the half-wave potential shifted by about  $0.3$  volt. When ethanalamines were employed as complexing agents one wave was obtained in the case of mono and diethanalamines, while with triethanolamine, two waves were noticed. The polarographic curve indicates that the first reduction step is due to sluggish equilibrium between different species of complexes.

#### 11. Argentio Compounds of Pyridine Dicarboxylic Acids.

BIRESWAR BANERJEE and PRIYADARANJAN RAY, Calcutta.

In continuation of our previous work on bipoisitive silver complexes of pyridine monocarboxylic acids, we have been able to prepare the argentic complexes of all

the dicarboxylic acids of pyridine with the exception of that of dinicotinic acid, as this last named acid has not yet been available in sufficient quantities for experimental work.

All these argentic complexes, viz. of quinolinic, cinchomeronic, isocinchomeronic, lutidinic and dipicolinic acids, are formed by the oxidation of silver nitrate and the acid concerned by means of alkali persulphate in aqueous medium. They all form red to dark-red finely divided crystals, more or less sparingly soluble in water. The argentic complex of dipicolinic acid has, however, been obtained in two different coloured forms, dark-red and green, the last one being produced at a lower temperature. The composition of all these complexes is given by the general formula  $\text{Ag}(\text{XH})_2$ , where  $\text{XH}_2$  = one molecule of the pyridine dicarboxylic acid. With the exception of cinchomeronic acid (3:4), all the complexes may be represented by a monomeric structure like that of argentic picolinate. The structure of the argentic cinchomerionate resembles possibly that of nicotinic or isonicotinic acid, being either dimeric, or polymeric with the formation of an unending two dimensional sheets and layers. The complexes are all decomposed by acids and alkalis.

As might be expected all these argentic complexes are paramagnetic and give a moment value of approximately  $1.73 \mu_B$ . X-ray powder photographs show that the green and chocolate modifications of the argentic complex of dipicolinic acid differ in their crystal structures. Cupric and argentic quinolinate crystallize with different water molecules and hence show, as might be expected, different X-ray patterns.

#### 12. Peroxy Titanium Sulfate.

M. S. MOHAN and C. C. PATEL, Bangalore.

Peroxy titanium sulphate having the formula  $\text{TiO}_2\text{SO}_4 \cdot 3.5 \text{H}_2\text{O}$  has been prepared for the first time by the reaction of freshly precipitated titanium hydroxide with calculated amount of sulphuric acid in presence of excess of hydrogen peroxide. The complex is very hygroscopic, and forms a stable solution in the minimum amount of water but hydrolyses on dilution. The complex is also soluble in alcohol and does not hydrolyse as in water. Spectral characteristics, thermal decomposition and stability of the complex with time have been studied.

#### 13. Formation of Complex Compounds between Ferric Chloride and Ammonium Thiocyanate. The System: $\text{FeCl}_3\text{-NH}_4\text{CNS-H}_2\text{O}$ .

C. S. PANDE and S. S. GUPTA, Lucknow.

The system: ferric chloride-ammonium thiocyanate-water has been studied by adopting the Monovariation method (Nayar and Pande: Proc. Ind. Acad. Sci. 27A, (1948), 286) for the preparation of the solutions as the method is eminently suited for the study of complexes in solution. Measurements of conductivity and viscosity of a series of mixed solutions of ferric chloride and ammonium thiocyanate indicate the existence of six definite complex compounds. Both curves of conductivity and viscosity shows breaks corresponding to  $\text{Fe}(\text{CNS})^{2+}$ ,  $\text{Fe}(\text{CNS})_2^+$ ,  $\text{Fe}(\text{CNS})_3^0$ ,  $\text{Fe}(\text{CNS})_4^-$ ,  $\text{Fe}(\text{CNS})_5^{2-}$  and  $\text{Fe}(\text{CNS})_6^{3-}$  complex ions.

#### 14. Formation of Complex Compounds between Uranyl Nitrate and Alkali Nitrates—Part I. The System: $\text{KNO}_3\text{-UO}_2(\text{NO}_3)_2\text{-H}_2\text{O}$ .

C. S. PANDE and S. S. Gupta, Lucknow.

A survey of literature shows that there is evidence for the formation of one definite complex compound between uranyl nitrate and potassium nitrate of the

formula:  $\text{KNO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$ . A systematic study now undertaken has revealed the presence of three complex compounds. The method adopted is to prepare stock solutions of M/10 strength of each of the two salts separately. 5 c.c. of  $\text{UO}_2(\text{NO}_3)_2$  are then pipetted out into a measuring flask of 50 c.c. capacity, the requisite quantity of  $\text{KNO}_3$  solution is added from a burette and the solution made upto the mark by addition of conductivity water. In this way 27 solutions are made in which the concentration of uranyl nitrate remains the same, while that of potassium nitrate varies systematically from (0.0M) to (0.052M.).

The physico-chemical properties, namely, density, viscosity, and conductivity of such a set of solutions have been studied. The values of conductivity and viscosity were then plotted against the concentration of potassium nitrate. Both curves indicate three breaks at concentrations corresponding to the compounds:  $\text{KNO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$ ;  $2\text{KNO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$  and  $4\text{KNO}_3 \cdot \text{UO}_2(\text{NO}_3)_2$ . Of these only the first one has been isolated.

#### 15. Formation of Complex Compounds between Urea and Alkaline Earth Halides —Part X.

C. S. PANDE and M. P. BHATNAGAR, Lucknow.

The existence of complex compounds between urea and halides of barium in aqueous solutions has already been reported in the earlier parts of this series (Ind. Sci. Cong. Abstracts, 1954 and 1955). A number of physico-chemical properties, namely, conductivity, viscosity, rheochor, surface tension, parachor, refractivity, depression in freezing point, etc., have been utilized in the investigation of these complexes in solution. In order to determine the nature of the nucleus of the complexion, the transport number measurements were made. The method employed by us was the same as adopted by Nayar and Pande (Proc. Ind. Acad. Sci. 27, (1948) 5A, 354).

The results obtained with the experiments on transport number indicate: (1) No significant variations in the values of Ba ion in the presence of urea at a molecular ratio of 2:1, showing almost no tendency for the formation of the compound  $2\text{BaX}_2 \cdot \text{CO}(\text{NH}_2)_2$ . (2) Different orders of magnitude in the values corresponding to other complexes assumed to exist in solution, prove the existence of such complexes. (3) Almost the same variations in all the three systems at the same molecular ratios, indicate the complexes found in all the systems are alike in nature.

Thus the existence of the complexes (1)  $\text{BaX}_2 \cdot \text{CO}(\text{NH}_2)_2$ , (2)  $\text{BaX}_2 \cdot 2\text{CO}(\text{NH}_2)_2$ , (3)  $\text{BaX}_2 \cdot 3\text{CO}(\text{NH}_2)_2$  (only in case of iodide) and (4)  $\text{BaX}_2 \cdot 4\text{CO}(\text{NH}_2)_2$ , (where  $\text{X} = \text{Cl}$ , Br or I), reported earlier becomes more convincing.

#### 15. Formation of Complex Compounds between Urea and Alkaline Earth Halides Part XI.

The Systems:  $\text{SrX}_2 - \text{CO}(\text{NH}_2)_2 - \text{H}_2\text{O}$

M. P. BHATNAGAR and C. S. PANDE, Lucknow.

Specific conductivity and relative viscosity measurements of the systems: (i)  $\text{SrCl}_2 - \text{CO}(\text{NH}_2)_2 - \text{H}_2\text{O}$ , (ii)  $\text{SrBr}_2 - \text{CO}(\text{NH}_2)_2 - \text{H}_2\text{O}$ , (iii)  $\text{SrI}_2 - \text{CO}(\text{NH}_2)_2 - \text{H}_2\text{O}$  reveal the existence of four complex compounds having the formulae:

(1)  $\text{SrX}_2 \cdot \text{CO}(\text{NH}_2)_2$ ,

(2)  $\text{SrX}_2 \cdot 2\text{CO}(\text{NH}_2)_2$ ,

(3)  $\text{SrX}_2 \cdot 3\text{CO}(\text{NH}_2)_2$  and

(4)  $\text{SrX}_2 \cdot 4\text{CO}(\text{NH}_2)_2$ .

( $\text{X} = \text{Cl}$ , Br or I).

The method of Monovariation was employed in the preparation of the solutions and investigation of the physico-chemical properties. A series of mixed solutions was prepared in such a way that the concentration of strontium halide was kept constant while that of urea varied systematically, in each set of solutions.

Kohlrausch's meter-bridge method and Ostwald's Visco-meter method were used in the investigation of the above properties. The values of conductivity and viscosity yielded curves when plotted against the variable concentration of urea. The curves showed four definite kinds which occur at exact stoichiometric ratios of the components corresponding to the compounds.

#### 17. Formation of Complex Compounds between Urea and Alkaline Earth Halides —Part XII. The Systems : $\text{CaX}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$ .

M. P. BHATNAGAR and C. S. PANDE, Lucknow.

After studying the systems : Barium halide—urea—water and Strontium halide—urea—water (loc. cit.), it was of interest to extend the investigations to calcium halides, to discover the analogous and other complex compounds, if any more, in solution.

The measurements of conductivity and viscosity of the mixed solutions of calcium chloride-urea, calcium bromide-urea and calcium iodide-urea, indicated the existence of five definite complexes in solution, the formulae of the compounds are :

- |  |  |
|--|--|
| (1) $\text{CaX}_2\cdot\text{CO(NH}_2)_2$ ,   | (2) $\text{CaX}_2\cdot 2\text{CO(NH}_2)_2$ ,   |
| (3) $\text{CaX}_2\cdot 3\text{CO(NH}_2)_2$ , | (4) $\text{CaX}_2\cdot 4\text{CO(NH}_2)_2$ and |
| (5) $\text{CaX}_2\cdot 6\text{CO(NH}_2)_2$ . |  |

#### 18. Reaction of Zirconyl Chloride with Mandelic Acid.

R. N. KAPUR and R. C. MEHROTRA, Lucknow.

The precipitation reaction between zirconyl chloride and mandelic acid has been studied under varying conditions. It has been found that even in the presence of much larger amounts of mandelic acid (upto 4 moles), the precipitate corresponds to a mono-mandelate. The composition of the precipitate varied on increasing the concentration of the reacting solutions and also by increasing the acidity of the medium above about 0.1 normal. In the presence of about 2.4 normal hydrochloric acid, the tetra-mandelate begins to be precipitated. A preliminary conductometric titration of zirconyl chloride with mandelic acid has also been carried out.

#### 19. Reaction of Zirconyl Chloride with Sodium Mandelate.

R. N. KAPUR and R. C. MEHROTRA, Lucknow.

The reaction between zirconyl chloride and sodium mandelate has been studied by analysing the precipitate obtained when the two solutions were mixed at the room temperature in varying molar ratio. Contrary to the assumptions of earlier workers, it has been shown that the precipitate in all the cases consists of mainly mono-mandelate. In this respect, the reaction has been shown to be similar to the reaction between zirconyl chloride and mandelic acid in dilute neutral solutions. However, the two reactions have been shown to differ in one respect that the precipitated mono-mandelate has a tendency to dissolve in the sodium mandelate when the ratio of mandelic acid : zirconium exceeds 2. A preliminary study of the reaction has also been carried out by conductometric and electrometric titration methods.

**20. Reaction of Titanium Isopropoxide and Ethoxide with Acetic Anhydride.**

K. C. PANDE and R. C. MEHROTRA, Lucknow.

The reaction of titanium ethoxide and isopropoxide with excess acetic anhydride results in the formation of a compound which corresponds in analysis to  $O[Ti(OAc)_3]_2$ . No tetra-acetate of titanium could be prepared by the above reaction. The reaction of titanium isopropoxide with acetic anhydride (one, two and three moles) was further tried. It has been shown that the reaction upto two moles is facile and the compounds, mono-acetate titanium tri-isopropoxide and di-acetate titanium di-isopropoxide were isolated for the first time by the above reactions. Further reaction of the di-acetate compound with acetic anhydride becomes slow and the tri-acetate titanium mono-isopropoxide formed reacts with the remaining di-acetate compound resulting finally in the formation of a product which corresponded in analysis to  $O[Ti(OPr)(OAc)_2]_2$ . This product on treatment with acetic anhydride has also been found to yield the oxygen bridge tri-acetate of titanium  $O[Ti(OAc)_3]_2$ .

**21. Mono- and Di-soaps of Aluminium.**

K. C. PANDE and R. C. MEHROTRA, Lucknow.

The existence of Tri-, di- and mono-soaps of aluminium has been in doubt for over three decades. Conflicting opinions have been expressed regarding the existence of all the three types. The authors have recently described the preparation and properties a number of aluminium tri-soaps. In this communication, the existence of di- and mono-soaps of aluminium has been established.

Mono- and di-isopropoxy laurates and stearates of aluminium have been prepared by metathetic reactions between aluminium isopropoxide and the calculated amount of the corresponding fatty acid. On treatment with acetyl chloride, the isopropoxy laurates have been shown to yield the corresponding mono- and di-chloro laurates. All these soaps give solution of low viscosity in benzene.

**22. Formation of Complex Compounds between Bivalent and Univalent Salts in Solutions—Part I. The System:  $Ba(NO_3)_2-MNO_3-H_2O$ .**

R. C. AGGARWAL, Lucknow.

Physico-chemical properties namely conductivity and depression in freezing points of the systems:  $Ba(NO_3)_2-MNO_3-H_2O$  (where  $M=Na, K \text{ \& } NH_4$ ), were studied by the monovariation method. On plotting the values of these properties against the concentration of the component that varies, smooth curves were obtained, indicating the absence of definite stoichiometric complex compounds in the systems studied. However, the deviations of the properties from the additivity suggest the existence of very unstable complex anions of barium in the above systems. The results obtained from cryoscopic and conductivity measurements are in conformity with transport number measurements of barium carried out earlier by Nayer and Aggarwal (Proc. Ind. Sci. Cong. Asso. III, 1952, p. 71).

**23. Formation of Complex Compounds between Bivalent and Univalent Salt in Solution—Part II. The System:  $M(NO_3)_2-KNO_3-H_2O$ .**

R. C. AGGARWAL, Lucknow.

From a study of the physico-chemical properties like density, relative viscosity, conductivity and depression in freezing points of the systems: strontium nitrate-potassium nitrate-water; zinc nitrate-potassium nitrate-water and mercuric nitrate-

potassium nitrate-water, it has been concluded that definite stoichiometric complexes do not exist in the above systems. Deviations from the additivity, however, indicate the presence of very unstable complex anions of strontium, zinc and mercury in the above systems.

**24. Formation of Complex Compounds between Bivalent and Univalent Salts in Solution—Part III. The System: Barium halide-alkali halide-water; and Strontium iodide-potassium iodide-water.**

R. C. AGGARWAL, Lucknow.

In Part (I & II) of this series from a study of the physico-chemical properties, it has been concluded that no definite stoichiometric complexes exist in the systems barium nitrate-alkali nitrate-water and strontium nitrate-alkali nitrate-water.

Since the halides have a much greater tendency to form complexes than nitrate, it was thought worthwhile to extend the investigations to the halides of barium and strontium. Studies of conductivity, freezing point depression and transport number of the systems barium halide-alkali halide-water and strontium halide-alkali halide-water show behaviour analogous to the nitrates. The results are, however, not at all extraordinary when it is seen that salts of strongly electro positive alkali and alkaline earth metals are involved.

**25. Formation of Complex Compounds between Bivalent and Univalent Salts in Solution—Part IV. System:  $\text{HgCl}_2\text{-KCl-H}_2\text{O}$ .**

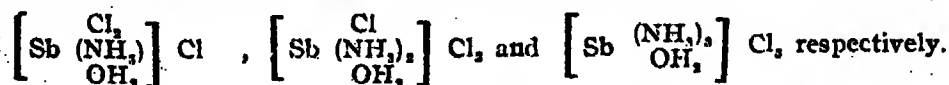
R. C. AGGARWAL, Lucknow.

A systematic study of the system  $\text{HgCl}_2\text{-KCl-H}_2\text{O}$  was undertaken with a view to reconcile the controversy in the literature regarding the exact number of complexes formed in the above system. Physico-chemical properties namely, freezing point depression, electrometric titrations and transport number have been studied. On plotting the values of freezing point depression and pH, abnormalities are observed at two places in each curve corresponding to the formation of the complexes  $\text{KHgCl}_2$  and  $\text{K}_2\text{HgCl}_4$ . The negative values of the transport number of mercury in mixtures of mercuric chloride and potassium chloride of the composition represented by the two complexes given above show that the complex compounds formed are fairly stable.

**26. Aquo-amino Antimony Chloride.**

H. K. DASH and S. PANI, Cuttack.

Mono-aquo-monammino dichloro antimonous chloride  $\text{SbCl}_2\text{.NH}_3\text{.H}_2\text{O}$ , mono-aquo-diammino-chloro antimonous chloride  $\text{SbCl}_2\text{.(NH}_3)_2\text{.H}_2\text{O}$  were prepared and analysed. The evidence of the existence of a triammino complex  $\text{SbCl}_2\text{.(NH}_3)_3\text{.H}_2\text{O}$  has been obtained. The probable structures of these complexes are—



**27. Acetyl Chloride as a Non-aqueous Solvent—Part III. Metathetical reactions in Acetyl Chloride.**

SARJIT SINGH SANDHU and RAM CHAND PAUL, Hoshiarpur.

Metathetical reactions between bases such as  $\alpha$ -picoline dimethyl-phenyl-benzyl ammonium chloride and demethyl aniline, and solvo acids, stannic chloride, zirconium



tetrachloride and titanium tetrachloride have been carried out in acetyl chloride as solvent. As a result of these reactions salt like complexes (dimethyl phenyl benzyl ammonium),  $\text{SnCl}_4$ ,  $\alpha$ -picoline  $(\text{CH}_3\text{CO})_2\text{SnCl}_4$ , 3-dimethyl aniline,  $2\text{SnCl}_4$ ,  $4\frac{1}{2}\text{CH}_3\text{COCl}$ ; (dimethyl-phenyl-benzyl ammonium),  $\text{ZrCl}_4$ ;  $\alpha$ -picoline  $(\text{CH}_3\text{CO})_2\text{ZrCl}_4$ ; 3(dimethyl aniline),  $2\text{ZrCl}_4$ ;  $3\frac{1}{2}\text{CH}_3\text{COCl}$ , (dimethyl-phenyl-benzyl ammonium),  $\text{TiCl}_4$ ,  $\alpha$ -picoline  $(\text{CH}_3\text{CO})_2\text{TiCl}_4$ , (dimethyl-aniline,  $\text{TiCl}_4$ ,  $\text{CH}_3\text{COCl}$  have been obtained. Tellurium tetrachloride has been employed as a Lewis acid and its reactions with solvo bases pyridine and  $\alpha$ -picoline and quaternary salt gave (pyridine)  $(\text{CH}_3\text{CO})_2\text{TeCl}_4$ ,  $\alpha$ -picoline  $(\text{CH}_3\text{CO})_2\text{TeCl}_4$  and (dimethyl-phenyl-benzyl ammonium),  $\text{TeCl}_4$ .

## 28. Studies on the Carbonates of Nickel

R. M. MALLYA, A. R. VASUDEVA MURTHY and K. R. KRISHNASWAMI,  
Bangalore.

Various compositions have been attributed to the basic carbonates of nickel obtained by the addition of the alkali carbonates to aqueous nickel salt. The physico-chemical studies carried out in the present investigation indicate that the composition of the basic carbonate is  $\text{NiCO}_3 \cdot 3\text{Ni}(\text{OH})_2 \cdot 2\text{H}_2\text{O}$ , when equivalent amounts of nickel sulphate and alkali carbonate are mixed. Even in presence of a large excess of sodium carbonate (three equivalents) the composition of the precipitate remains the same. The physical properties of the precipitate, however, greatly vary depending on ageing of the precipitates. These properties have been investigated by the measurement of the surface area of the precipitate by the dye-adsorption method and the B.I.T. method. In general, it has been noticed that the surface area of the precipitate increases with the ageing of the precipitate. An attempt has been made to explain the variation of the catalytic property of nickel when prepared by different methods. The effect of temperature on the decomposition of the basic carbonate has been investigated using thermogravimetric analysis and also thermal decomposition in vacuum. The compound loses mostly water between 100 and 220°C. At higher temperatures (260 to 420°C) the carbon dioxide is the main product of decomposition.

## 29. Studies in Corrosion of Brass.

A. K. M. TRIVEDI and M. N. DESAI, Ahmedabad.

Brass vessels are frequently utilized in India for domestic use including cooking and serving food. An attempt is made to study the corrosion of brass in aqueous solutions of salts, organic acids, and in acidic substances of domestic use like Tamarind, Kokum, Hog-plums, Lemons, Tomatoes etc. Both alpha and alpha-beta brasses were employed. Studies in corrosion were followed by (A) Loss or gain in weight, (B) Determining percentage of copper and zinc dissolved by the medium, (C) Changes in pH and (D) in some cases by microphotographs of the corroded specimens.

Generally it has been found that Sodium Chloride is the most corrosive substance and Sodium Sulphate is the least corrosive. Corrosion is least at pH 4.15 and 5.25 when solutions of various pH (2.2 to 7.9) were employed. The corrosive power of Acetic, Malic, Citric and Tartaric acid was in that order. Ripe tomatoes containing tartaric acid are least corrosive while kokum was more corrosive than tamarind.

Immersion of an  $\alpha$ -brass plate in N/1000 tartaric acid leads to the development of a permanent impression on the plate.

## ANALYTICAL CHEMISTRY

30. Di- $\beta$ -hydroxy ethyl rubeanic acid as a colorimetric reagent.

J. XAVIER and PRIYADARANJAN RAY, Calcutta.

Di- $\beta$ -hydroxy ethyl rubeanic acid like rubeanic acid and its substituted derivatives reacts with metal salts giving coloured inner complexes. These reactions have been made use of in the detection and determination of copper, cobalt, nickel and palladium. Spot tests carried out on a porcelain plate gave the following identification and concentration limits: copper 0.05 $\gamma$  ( $1.8 \times 10^5$ ); cobalt 0.025 $\gamma$  ( $1.16 \times 10^5$ ); nickel 0.025 $\gamma$  ( $1.16 \times 10^5$ ), and palladium 0.06 $\gamma$  ( $1.5 \times 10^5$ ). Hydroxy ethyl rubeanic acid serves also as a useful reagent for the spectrophotometric determination of these metals, except cobalt. Copper was determined in acetone-pyridine medium, measuring the optical density at 390 m $\mu$ , between 10.1 and 11.0 pH. The system obeyed Beer's law and gave a sensitivity of 0.007 $\gamma$  Cu per cm<sup>2</sup> (Sandell) and 0.03 $\gamma$  Cu per cm<sup>2</sup> (practical). Alcoholic-pyridine solutions of the nickel complex gave fairly constant readings after 45 minutes, when measured at 500 m $\mu$  and at 8.5 to 9.0 pH. The system followed Beer's law, giving a sensitivity of 0.009 $\gamma$  Ni per cm<sup>2</sup> (Sandell) and 0.03 $\gamma$  Ni per cm<sup>2</sup> (practical). For palladium estimations 95% ethyl alcohol was found to be the best solvent. The colour intensity remained constant between 1.0 to 9.0 pH. The optical density was measured at 390 m $\mu$  and was found to follow Beer's law. The sensitivity was given by 0.011 $\gamma$  Pd per cm<sup>2</sup> (Sandell) and 0.04 $\gamma$  Pd per cm<sup>2</sup> (practical).

The reagent was prepared by warming rubeanic acid with an alcoholic solution of ethanol amine. The product on recrystallisation from ethyl alcohol gave orange-yellow rhombic plates, melting at 93-94°C.

## 31. 2-Mercapto quinoline (thiocarbostryl) as a colorimetric reagent for copper and palladium.

J. XAVIER and PRIYADARANJAN RAY, Calcutta.

2-Mercapto quinoline is introduced as a sensitive and selective reagent for copper. Spot test determinations gave limits of identification as 0.03 $\gamma$  Cu at a concentration limit of 1:430,000 on filter paper and as 0.025 $\gamma$  Cu at a concentration limit of 1:1,000,000 on spot plate. Copper, palladium and bismuth, after separation by employing the disc chromatographic method, could be detected in presence of each other by spraying an alcoholic solution of 2-mercapto quinoline and subsequently exposing the chromatogram to hydrochloric acid fumes.

Copper was estimated spectrophotometrically in 1:1 aqueous propionic acid medium. At 450 m $\mu$  the yellow colour showed adherence to Beer's law, giving a sensitivity of 0.0045 $\gamma$  Cu per cm<sup>2</sup> (Sandell). Mineral acids or neutral salts when present in excess diminished the colour intensity. The orange-yellow colour developed by palladium salts with 2-mercapto quinoline in alcoholic medium served as the basis of estimating the metal spectrophotometrically. The system obeyed Beer's law, when the optical density was measured at 450 m $\mu$  in the pH range 1.4-2.8. The sensitivity was 0.009 $\gamma$  Pd per cm<sup>2</sup> (Sandell) and 0.05 $\gamma$  Pd per cm<sup>2</sup> (practical).

2-Mercapto quinoline was prepared by heating carbostryl with phosphorus pentasulphide at 135-145°C (Ross, *Ber.*, 21, 620).

**32. Colorimetric determination of Uranium by Organic Reagents.**

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

Ware (1945) suggested the use of several new organic reagents for the colorimetric determination of Uranyl ion. In recent publications (1956) we have described the use of sodium alizarin sulphonate, Ammonium aurin tricarboxylate (1956) and Rhodizonic acid (1957) for the production of characteristic colours with various metallic ions. Raghava Rao and coworkers (1955) have also reported the use of Alizarin Red S for the colorimetric determination of uranium and thorium.

In this paper we have shown that Ammonium Aurin Tricarboxylate, 1:8-Dihydroxy-naphthalene-3:6-disulphonic acid, sodium alizarin sulphonate and 7-Iodo-8-Hydroxyquinoline-5-sulphonic acid yield coloured complexes with uranyl compounds, and this can be utilised for determining uranium on a micro-scale colorimetrically.

**33. Colorimetric determination of Manganese with Benzo-hydroxamic Acid.**

AMIYA KUMAR CHAKRABURTTY, Calcutta.

Manganese salts have been found to react with many hydroxamic acids in alkaline medium to form red-violet coloured complexes. The reaction with benzo-hydroxamic acid above pH 9.5 is rapid as well as sensitive and has been utilised for working out a method for the colorimetric estimation of manganese. The coloured solution has maximum absorption in the region 480-510 m $\mu$ . Beer's law holds good throughout the instrumental range. Sensitivity  $\cdot 014\gamma$  Mn/cm $^2$ .

**34. Use of Molono-hydroxamic Acid as a Colorimetric Reagent.**

AMIYA KUMAR CHAKRABURTTY, Calcutta.

The sensitive colour reactions given by uranium (vi), vanadium (v), molybdenum (vi) and iron (iii) with molono-hydroxamic acid have been utilised for working out methods for the estimation of traces of these elements spectrophotometrically.

Uranium forms a bright yellow colour, the maximum intensity of which remains unaltered in the pH-range 6.5 to 8.5. The colour given by vanadium is reddish brown, its optimum pH-limit being 7 to 8.5. The intensity of the yellow colour of molybdenum also is independent of pH in the range of 6.5 to 8. The absorption of all the above colour systems increases continuously towards the ultra-violet region. The absorption of the reagent itself above 360 m $\mu$  being negligible, measurements in all cases were carried out between 360 to 400 m $\mu$ . Iron gives an orange colour of constant intensity above pH 6, having its absorption maxima in the range 430-440 m $\mu$ . The colour intensity does not decrease even upto pH 11.5. In all these systems Beer's law was found to hold good at all concentrations within the instrumental range. Sensitivity:  $\cdot 16\gamma$  U/cm $^2$  (360 m $\mu$ ) and  $\cdot 3\gamma$  U/cm $^2$  (at 400 m $\mu$ ) for uranium;  $\cdot 025\gamma$  V/cm $^2$  (at 360 m $\mu$ ) for vanadium,  $\cdot 06\gamma$  Mo/cm $^2$  (at 360 m $\mu$ ) and  $\cdot 13\gamma$  Mo/cm $^2$  (at 400 m $\mu$ ) for molybdenum and  $\cdot 026\gamma$  Fe/cm $^2$  (at 440 m $\mu$ ) for iron.

**35. Glycinehydroxamic acid as a Colorimetric reagent.**

AMIYA KUMAR CHAKRABURTTY, Calcutta.

Studies on the soluble coloured complexes of glycine hydroxamic acids with iron, molybdenum, vanadium and cerium have revealed the possibility of using the reagent for the colorimetric determination of small amounts of these elements.

Iron gives an orange colour in the pH range 6-10.5 and can be estimated at 430-440  $m\mu$ , the region of maximum absorption. The colour system follows Beer's law within the measurable limit. Sensitivity  $0.025\gamma$  Fe/cm<sup>2</sup>. Molybdenum also gives yellow colour, the intensity of which remains unchanged within the pH range of 5-7.7 when measured at 400  $m\mu$  or preferably at a lower value of 370  $m\mu$ , as the intensity of absorption increases continuously towards the ultraviolet. The system follows Beer's law. Sensitivity  $0.06\gamma$  (at 370  $m\mu$ ) and  $0.12\gamma$  Mo/cm<sup>2</sup> at 400  $m\mu$ . The intensity of vanadium colour remains unchanged in the pH range 6-5-8 and is also proportional to vanadium concentration. The colour intensity as in the case of molybdenum increases continuously towards the ultraviolet. Sensitivity  $0.06\gamma$  V/cm<sup>2</sup> at 360  $m\mu$ .

Cerous salts in presence of the reagent slowly develops a red-brown colour above pH 9.5 which serves as a ready method for the detection and determination of cerium, the colour development is completed after 15 minutes and remains unchanged for more than an hour. Sensitivity  $0.05\gamma$  Ce/cm<sup>2</sup> when measured at 370  $m\mu$ .

### 36. o-Hydroxy acetophenone oxime as an analytical reagent for the colorimetric estimation of Vanadium.

SAILENDRA NATH PODDAR, Calcutta.

The present paper introduces o-hydroxy acetophenone oxime as a new, stable and widely applicable colorimetric reagent for the estimation of vanadium. In acid solution vanadates give a reddish-brown precipitate with the reagent. The precipitate is highly soluble in alcohol, giving a reddish-yellow colour which is maximum at pH range 2.5-3.7. The intensity is fairly high permitting the determination of very small amount of vanadium.

The optical density of coloured solution of vanadium with the reagent increases continuously towards the shorter wavelengths, the reagent also shows considerable absorption towards ultra-violet, but in acidic solutions (pH 2-4), the absorption is quite negligible at 400  $m\mu$ . Hence, all measurements were made at this wavelength.

All the colour measurements were made in 50% ethanol medium with a Unicam SP 600 spectrophotometer using 1 cm. glass cell, the pH measurements were made in a Cambridge bench type pH meter. All the reagents used were chemically pure of G.R. quality.

The sensitivity of the colour reaction was found to be  $0.06\gamma$  per cm<sup>2</sup>. The colour system obeyed Beer's law over a wide range of vanadium concentration. The colour was stable for about 8 hrs. and temperature  $20^{\circ}$  to  $50^{\circ}\text{C}$  was found to have no effect on it. An excess of reagent equivalent to 40-60 times that of metal was required for the development of the maximum colour. Common ions like those of alkali metals, alkaline earth metals, aluminium, magnesium, nickel, cobalt, zinc, cadmium, mercury and lead as well as chloride, bromide, iodide, sulfate, nitrate, nitrite, phosphate, molybdate, and tungstate do not interfere; ferric ion can be effectively masked with phosphoric acid, but fluoride, citrate, tartate, oxalate ions and also copper, titanium and palladium were found to interfere seriously with the estimation of vanadium with this reagent.

### 37. o-Hydroxy Acetophenone Oxime as an analytical reagent, Part I.

SAILENDRA NATH PODDAR, Calcutta.

The reactions of o-hydroxy acetophenone oxime with various metallic ions have been studied on a qualitative basis and compared with those of salicylaldoxime, of which it may be regarded as a methyl derivative. As the substitution of a

methyl group is known to introduce a considerable modification in the properties of organic molecules due to its hyperconjugating power, a systematic investigation of its properties as an analytical reagent was made. The result of such study has now established the usefulness of the reagent for the gravimetric estimation of copper, nickel, palladium, vanadium, and titanium as well as for the colorimetric estimation of iron, uranium and vanadium.

The complex copper, nickel, palladium, vanadium, uranium and titanium compounds have been prepared in the pure state and their properties studied. Magnetic susceptibility measurements showed that the copper compound is an usual paramagnetic ( $\mu=1.85$ ); the nickel and palladium complexes are diamagnetic, suggesting thereby their square-planar structures with  $dsp^2$  bonds; the titanium and uranyl complexes are diamagnetic; the vanadium complex is also diamagnetic which, from a consideration of its reddish-brown colour seems to suggest that the compound contains a pentavalent vanadium with  $d^2sp^3$  bond.

**38. o-Hydroxy Acetophenone Oxime as an Analytical Reagent, Part II. Gravimetric estimation of copper and nickel and their separation from each other as well as from other metals.**

SAILENDRA NATH PODDAR, Calcutta.

Gravimetric estimation of copper and nickel and their separation from each other as well as from other metals with good results by means of o-hydroxy acetophenone oxime has been described in this paper. Copper and nickel are quantitatively precipitated by this reagent at pH 2.1-8.0 and 4.8-8.5 respectively. The precipitates after drying at  $105^\circ-110^\circ\text{C}$  have the composition  $M(C_8H_7O_2N)_2$ , where M represents copper or nickel. O-hydroxy acetophenone oxime being the methyl derivative of salicylaldoxime, the solubilities of its metallic complexes appear to be less, and the stabilities more, than those of salicylaldoxime complexes, as is evident from the pH values of complete precipitation of copper and nickel.

Copper and nickel have been estimated in varying amounts with this reagent. In a mixture of copper and nickel ions, copper was separated by precipitating at pH 2-3. No entrainment of nickel in the copper precipitate was observed. Nickel was then estimated in the combined filtrate and washings by adjusting the pH at 5.5-5 (with the addition of further quantity of reagent is necessary), when the nickel compound was completely precipitated.

Copper has been estimated at controlled pH without any interference in presence of lead, mercury, cadmium, arsenic, cobalt, manganese, zinc, uranium, magnesium and phosphoric acid. Iron (III), antimony, vanadium and bismuth, when present, were masked by using tartaric acid.

Estimation of nickel was also carried out at controlled pH, without any interference, in presence of lead, mercury, zinc, cadmium, manganese and magnesium. Iron (III) and bismuth, if present were masked as usual by tartaric acid. Cobalt, if present in quantities four times that of nickel, gives a slightly higher value for the latter.

**39. Complex Compounds of Ortho-hydroxy Dibenzoylmethane with Bi- and Tervalent Metals.**

SAILENDRA NATH PODDAR, Calcutta.

Complex compounds of ortho-hydroxy dibenzoylmethane with copper, nickel, cobalt (II), manganese (II), uranium, and iron (III) have been prepared in the pure state. The ketone behaves as a bi-dentate ligand. The properties of the complexes have been studied and their structures discussed. Further work on the use of the substance as a colorimetric reagent is in progress.

**40. Sodium Alizarin-sulphonate as a Colorimetric Reagent in Inorganic Analysis; Effect of pH on the structure of the compound and colour reactions with metallic ions.**

ANIL K. MUKHERJI and ARUN K. DEY, Allahabad.

Alizarin sulphonic acid known as Alizarin Red S has been found to produce colour reactions with various metallic ions. The colour produced is very sensitive with lead, copper, iron, aluminium, uranium, thorium and titanium. The change of colour with pH of Alizarin Red S has been followed spectrophotometrically and the colour has been found to change from light yellow to red and violet with progressive increase in pH. The possible structures have been discussed and the observed wavelengths in the peaks of maximum absorption have been found to be in general agreement with those calculated by Kuhn's expression deduced from wave-mechanical considerations.

**41. Separation of Niobium from Tantalum, Titanium, Tin and Antimony by 8-Hydroxy-quinoline (Oxine).**

G. K. BELLEKAR and V. T. ATHAVALE, Bombay.

From solutions of earth acids in tartrate medium and adjusted to a pH=6.0, niobium can be quantitatively precipitated by oxine. From the filtrate, tantalum can be recovered by tannin. Titanium is distributed in the two fractions. Each fraction is to be corrected for titanium by estimating it by the peroxide method.

For earth acids obtained by direct complexone tannin procedure and containing tin and antimony oxides, the same procedure for separation of niobium in the tartrate medium is followed. However, prior to the recovery of tantalum by tannin, tin and antimony in the oxine-filtrate are removed by precipitation as sulphides by hydrogen sulphide.

**42. Determination of Cadmium as Salicylaldoximate by Non-Aqueous Titration.**

MIHIR NATH DAS, Calcutta.

Cadmium can be quantitatively precipitated from aqueous solution with salicylaldoxime at pH 8-9, but the precipitate has no definite composition, being a variable mixture of mono- and di-salicylaldoximates, and hence is useless for quantitative analysis. The precipitate can, however, be used for estimation of cadmium, by converting it into acetate and then titrating the acetate in glycol-isopropyl alcohol mixture with standard perchloric or hydrochloric acid in the same solvent, using thymol blue as indicator. Excellent results have been obtained by this method, the accuracy being of the order of  $\pm 0.3\%$ . The method can be conveniently used for analysis of mixtures of copper, cadmium and lead. All these metals are precipitated by salicylaldoxime, but at different pH values, so that quantitative separation can be effected by adjusting the pH of the solution, and then each constituent can be separately estimated by non-aqueous titration after conversion to the acetate.

**43. Gravimetric Determination of Mercury.**

G. R. SOMAYAJULU, Calcutta.

Mercurous salts have been disproportionated into mercuric state and metallic mercury by addition of potassium iodide. The metallic mercury is filtered off, dried and weighed. From the weight of mercury thus obtained the amount of mercurous salt is calculated. Alternatively after disproportionation of the mer-

curous salt with potassium iodide, the mercury in the mercuric state also is reduced to the metallic state by treatment with formaldehyde and alkali. The weight of mercury thus obtained corresponds to the total amount of mercury present in the mercurous salt. The second procedure is also applicable to the analysis of mercuric salts. The above procedures constitute reliable gravimetric procedures for the determination of mercury.

**44. Gravimetric Estimation of Lithium as lithium phosphate using potassium phosphate reagent.**

K. N. VISHWESHWARAI, C. C. PATEL and K. R. KRISHNASWAMI,  
Bangalore.

Potassium phosphate reagent of pH 9.5 prepared by mixing potassium hydroxide and orthophosphoric acid has been successfully employed for the gravimetric estimation of lithium as lithium phosphate ( $\text{Li}_3\text{PO}_4$ ) in 60% ethyl alcohol medium. The amount of lithium that could be determined is from 5 mg. to over 1000 mg., even in presence of other alkali metal salts whose limits of tolerance are also determined. A solubility correction of 0.36 mg. of lithium for every 50.0 ml. of the precipitating medium is also to be added to the value of lithium obtained gravimetrically by this method.

**45. Study on the separation of cent per cent  $\text{UX}_1$  from aged uranium solution and the importance of calcium as a non-isotopic diluent for thorium in the distribution studies of trace amounts of thorium.**

B. C. PURKAYASTHA and S. N. BHATTACHARYA, Calcutta.

A search in the literature shows that there is no simple method to separate cent per cent  $\text{UX}_1$  in equilibrium with  $\text{U}_1$  without any trace of carrier in it. In the present investigation  $\text{UX}_1$  has been carried quantitatively from aged uranyl nitrate solution by coprecipitating it with  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  in acetic acid solution. The precipitate of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  containing cent per cent  $\text{UX}_1$  was carried with  $\text{Fe}(\text{OH})_3$  scavenger—thus separation from calcium was effected. The  $\text{Fe}(\text{OH})_3$  precipitate containing  $\text{UX}_1$  was dissolved in about 6N hydrochloric acid and was subjected to continuous extraction with isopropyl ether and thus about cent per cent  $\text{UX}_1$  was left in the aqueous layer. Quantitative recovery in each stage was tested. The result was also verified by absolute  $\beta$ -counting through a delimiting diaphragm. The choice of calcium as the carrier for  $\text{UX}_1$  is much better than lanthanum or zirconium because it can easily be separated from  $\text{UX}_1$  by solvent extraction, ion exchange, chromatography and other chemical procedures.

It has also been observed that  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  carries  $\text{UX}_1$  uniformly and that in the study of distribution of trace amounts of thorium with the  $\text{UX}_1$  as indicator, a nonisotopic diluent like calcium can be used conveniently in the analysis of trace quantities of thorium by isotopic dilution.  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  is a primary standard. But  $\text{Th}(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$  as has been used by certain authors cannot be called a primary standard.  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  spreads well and a uniform distribution of  $\text{UX}_1$  has always been found. In the tracer study of thorium, analysis by isotopic dilution with  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  is much more reliable and convenient. Even in the estimation of calcium by isotopic dilution with  $\text{Ca}^{44}$  (0.255 Mev) as indicator we meet with low energy  $\beta$ -particles where change in self absorption per mg. per  $\text{cm}^2$  is very great and error may always creep in. But in case of  $\text{UX}_1$  as an indicator  $\text{UX}_1$  emits energetic  $\beta$ -s (2.32 Mev). It has been observed by us that changes in self absorption and self scattering is so negligible over a wide range that any correc-



tion against standard is not necessary for about 50 mg. difference in mass units with the unknown sample. Moreover  $UX_1$  is always available in laboratories. From such considerations the use of  $UX_1$  as indicator in the analysis of calcium by isotopic dilution is much better than  $Ca^{45}$ .

**46. Study on the importance of calcium as a non-isotopic carrier for rare earths and its use in removing the last trace of rare earths.**

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta.

In our previous work (same journal) on removing and estimating  $UX_1$  activities importance of  $CaC_2O_4 \cdot H_2O$  has been described. In the present work estimation of rare earth activities and removal of the last trace of rare earths by  $CaC_2O_4 \cdot H_2O$  from materials that find indispensable application in atomic science has been studied.  $Pm^{144}$  (half life—2.26y;  $\beta$ -energy 0.229 Mev.) has been used as a representative rare earth. Lanthanum (inactive) has been used as a carrier in some operations. It has been shown that under experimental conditions  $Pm^{147}$  activities distributes uniformly along with  $CaC_2O_4 \cdot H_2O$  precipitate. The distribution is so uniform that  $CaC_2O_4 \cdot H_2O$  has been used in determining rare earth activities by isotopic dilution or calcium can be determined by isotopic dilution using rare earth activities as indicator. Results are always within statistical accuracy.

It has been shown that rare earths can be uprooted from U, Th, Zr, Al, and Be to the desired level by calcium oxalate. ( $CaC_2O_4 \cdot H_2O$ ) as scavenger. In this work the ratio of rare earths to uranium etc., elements (mentioned above) has been brought to about  $1:10^7$ . It has been claimed to be a very simple laboratory process of decontamination. The cause of uniform distribution of  $UX_1$  and rare earths activities in  $CaC_2O_4 \cdot H_2O$  will form the subject matter of our future investigations.

**47. On the study of indirect application of Radio-active Nuclei in analytical chemistry. Part I: Estimation of Ag. and I using  $I^{131}$ .**

B. C. PURKAYASTHA and V. R. PAI VERNEKER, Calcutta.

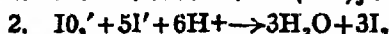
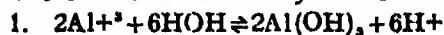
Application of Radioactive Nuclei in analytical chemistry with special reference to the estimation in ultra-micro quantities of substances has been briefly discussed. It has been shown that through indirect method of analysis by radio-active nuclei, elements of  $\gamma$  ( $10^{-8}$  g) order of magnitude can be estimated with fair degree of accuracy. In the present investigation the estimation of Ag and I was undertaken using  $I^{131}$  as a measuring indicator. The principle involved in such estimations is as follows:—excess of iodine (double or triple the theoretical equivalent amount of Ag) as KI containing  $I^{131}$  is added to unknown Ag in acid solution; the trace of AgI completely precipitates and is carried along with zirconium phosphate. From the loss in activity of  $I^{131}$  in the filtrate the amount of Ag present can be calculated. In case we take known amount of Ag, unknown iodide can also be estimated under the same condition. It has been found that even one micro gram ( $10^{-6}$  g) of Ag can be estimated within statistical accuracy ( $\pm 2\%$ ). The operations do not take more than half an hour. It can be inferred from our study on the adsorption of I on zirconium phosphate (the carrier we used in our experiment) that zirconium phosphate is a true carrier of AgI. It carries AgI even beyond the solubility limit. In case of quantities below one micro gram adsorption of I on zirconium phosphate seems to bring in some error. This error can also be avoided and a lower limit can be reached on further study.



**48. On the study of indirect application of Radio-active Nuclei in analytical chemistry. Part II: Estimation of weakly basic elements using  $I^{131}$**

B. C. PURKAYASTHA and V. R. RAI VERNEKER, Calcutta.

As an extension to our study on indirect radiochemical estimation determination of weakly basic elements by allowing hydrolysis to completion with  $IO_3$ , I mixture, was taken up. Aluminium in potash-alum has been estimated by determining the iodine liberated by the following reactions:



Iodine liberated is distilled and collected in suitable absorbers to make possible to estimate the iodine by gravimetric, volumetric and radioactive methods. In case of volumetric estimation iodine was collected in KI solution and titrated against hypo. In case of gravimetric estimation iodine is collected in sodium sulphite, sodium carbonate mixture and precipitated as AgI. Gravimetric procedure also leads us to microdeterminations because the amount of AgI is about 26 times the weight of aluminium. In case of Milligram amount of aluminium, iodine liberated can be estimated directly by isotopic dilution by the use of  $I^{131}$ . In case of still lower orders, indirect radiochemical procedure with  $I^{131}$  was adopted. The principle as stated in our previous communication is to add a known amount of Ag ( $\frac{1}{2}$  equivalent amount of I in acid solution) and coprecipitate the AgI along with Zirconium phosphate. Aluminium upto the limit of  $40\gamma$  ( $40 \times 10^{-6}g$ ) has thus been estimated with a fair degree of accuracy. It does not take more than two hours to complete the whole operation. When Aluminium concentration goes below 40 micrograms per 300 c.c., quantity of iodine liberated is found to be some what higher. The causes of such troubles have been discussed and will form the subject matter of further study. It has been urged that this procedure of determining weak bases will be very convenient in dealing with highly active preparations. Possible application of this principle to routine chemical analysis has also been discussed.

**49. Bismuthiol II as an Analytical Reagent. Part I: Estimation of Bismuth.**

A. K. MAJUMDAR and M. M. CHAKRABARTY, Calcutta.

The estimation of bismuth by the reagent Bismuthiol II is studied critically. The effect of acidity, reagent concentration and interfering ions are given in detail. The maximum acidity that may be tolerated for the complete precipitation of bismuth is 0.3N in nitric acid, 0.5N in hydrochloric and 1N in sulphuric acids. Higher acidity than 0.1N decomposes the reagent present in excess. In 0.1N nitric acid bismuth has been separated from a number of ions like  $Al^{+3}$ ,  $Cr^{+3}$ ,  $Th^{+4}$ , rare earths,  $Zr^{+4}$ ,  $Ti^{+4}$ ,  $UO_2^{+2}$ ,  $Be^{+2}$ ,  $Mn^{+2}$ ,  $CO^{+2}$ ,  $Ni^{+2}$ , Mg, alkalis, alkaline earths,  $SO_4^{-2}$ ,  $Cl^{-1}$ ,  $C_2O_4^{-2}$  and from  $Fe^{-3}$  and  $Ce^{+3}$  in 0.1N hydrochloric acid. In presence of citrate or tartrate it can be separated from  $As^{+3}$ ,  $Ce^{+4}$ ,  $MoO_4^{-2}$  and  $WO_4^{-2}$  at pH 1.5 to 2.5. When  $Hg^{+2}$ ,  $Pd^{+2}$ ,  $Pb^{+2}$ ,  $Cd^{+2}$ ,  $Cu^{+2}$ ,  $Ag^{+1}$  and  $Tl^{+1}$  are present they are first precipitated by the reagent at pH 6 to 8 in presence of citrate or tartrate and bismuth is estimated gravimetrically in the acidified filtrate. Ions as  $F^{-1}$  and  $PO_4^{-3}$  that form insoluble compound with bismuth,  $Sb^{+3}$  and  $Sn^{+2}$  that form less soluble compound with the reagent and  $Fe^{+3}$ ,  $CO_3^{-1}$ ,  $CrO_4^{-2}$ ,  $AsO_4^{-3}$  that act as oxidising agents interfere.

**50. Bismuthiol II as an Analytical Reagent. Part II: Estimation of Lead.**

ANIL KUMAR MAJUMDAR and BHU RATNA SINGH, Calcutta.

Lead was estimated as Bismuthiol II complex of composition  $(C_4H_5N_2S_2)_2Pb$  by precipitating it from its chloride or nitrate solution in presence of a mineral

acid, acetic acid, tartrate or cyanide. The estimation is quantitative up to a maximum pH of about 6.5. The lead-Bismuthiol II complex is stable up to about 311°C and the conversion factor is 0.315. The method affords a complete separation of lead from alkalis and alkaline earths,  $\text{Be}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{Zn}^{+2}$ ,  $\text{Mn}^{+2}$ ,  $\text{Co}^{+2}$ ,  $\text{Ni}^{+2}$ ,  $\text{Fe}^{+2}$ ,  $\text{Fe}^{+3}$ ,  $\text{Cr}^{+3}$ ,  $\text{Al}^{+3}$ , rare earths,  $\text{Ti}^{+4}$ ,  $\text{Zr}^{+4}$ ,  $\text{Th}^{+4}$ ,  $\text{UO}_2^{+2}$ ,  $\text{Pd}^{+2}$ ,  $\text{As}^{+3}$ ,  $\text{Sb}^{+3}$ ,  $\text{Cl}^{-1}$ ,  $\text{SO}_4^{-2}$ ,  $\text{PO}_4^{-3}$ ,  $\text{AsO}_4^{-3}$ ,  $\text{MoO}_4^{-2}$  and  $\text{WO}_4^{-2}$ . Among the sulphide group members  $\text{Ag}^{+1}$ ,  $\text{Au}^{+3}$ ,  $\text{Hg}^{+1}$ ,  $\text{Hg}^{+2}$ ,  $\text{Tl}^{+1}$ ,  $\text{Tl}^{+3}$ ,  $\text{Cd}^{+2}$  and platinum metals, except  $\text{Pd}^{+2}$ , interfere while oxidising agents decompose the excess reagent.  $\text{Bi}^{+3}$ ,  $\text{Cu}^{+2}$  and  $\text{Sn}^{+2}$ , do not interfere up to a maximum limit of 30 mg., 50 mg., and 250 mg., respectively.

#### 51. Bismuthiol II as an Analytical Reagent. Part III: Estimation of Palladium.

A. K. MAJUMDAR and M. M. CHAKRABARTY, Calcutta.

Bismuthiol II completely precipitates palladium from a high acidity to a high pH as  $\text{Pd}(\text{C}_6\text{H}_5\text{N}_2\text{S}_2)_2$ , which is stable even at 250°C. In 0.1N hydrochloric acid palladium can be estimated in presence of  $\text{Fe}^{+2}$ ,  $\text{Al}$ ,  $\text{Cr}$ ,  $\text{Th}$ ,  $\text{Ce}^{+3}$ ,  $\text{Zr}^{+4}$ ,  $\text{Ti}^{+4}$ ,  $\text{UO}_2^{+2}$ ,  $\text{Be}$ ,  $\text{Mn}$ ,  $\text{Co}$ ,  $\text{Ni}$ ,  $\text{Mg}$ ,  $\text{PO}_4^{-3}$ ,  $\text{AsO}_4^{-3}$ , rare earths, alkali and alkaline earths. In presence of citrate or tartrate at a pH 1.5–2.85 palladium can be separated from  $\text{Ce}^{+4}$ ,  $\text{WO}_4^{-2}$ ,  $\text{MoO}_4^{-2}$ ,  $\text{AsO}_4^{-3}$  and at a pH 6.2–8 from  $\text{As}^{+3}$ ,  $\text{Bi}^{+3}$ ,  $\text{Sn}^{+4}$ ,  $\text{Sb}^{+3}$ ,  $\text{Zn}$ ,  $\text{Zr}^{+4}$ ,  $\text{Ti}^{+4}$ ,  $\text{Th}$ ,  $\text{Fe}^{+3}$ ,  $\text{Ce}^{+3}$ ,  $\text{Al}$ ,  $\text{Cr}$ ,  $\text{Be}$ ,  $\text{UO}_2^{+2}$  rare earths, alkalis and alkaline earths. With E D T A as a complexing agent and at a pH range 4.75 to 8.2 it is possible to estimate palladium in presence of  $\text{Tl}^{+1}$ ,  $\text{Cu}^{+2}$ ,  $\text{Pb}$ ,  $\text{Bi}^{+3}$ ,  $\text{As}^{+3}$ ,  $\text{Sb}^{+3}$ ,  $\text{Mn}$ ,  $\text{Ni}$ ,  $\text{Co}$ ,  $\text{Zn}$ ,  $\text{Be}$ ,  $\text{Ti}^{+4}$ ,  $\text{UO}_2^{+2}$ ,  $\text{Fe}^{+3}$ ,  $\text{Al}$ ,  $\text{Cr}$ ,  $\text{Th}$ ,  $\text{Zr}^{+4}$ ,  $\text{Ce}^{+3}$ ,  $\text{Ce}^{+4}$ ,  $\text{Mg}^{+2}$ ,  $\text{CrO}_4^{-2}$ ,  $\text{AsO}_4^{-3}$ ,  $\text{MoO}_4^{-2}$ ,  $\text{AsO}_4^{-3}$ ,  $\text{WO}_4^{-2}$ ,  $\text{VO}_4^{-3}$ , rare earths, alkali and alkaline earths. Potassium iodide helps the separation of palladium from  $\text{Ag}^{+1}$ ,  $\text{Pb}^{+2}$  and  $\text{Hg}^{+2}$  at a pH 6–8.  $\text{Tl}^{+1}$  and  $\text{Ag}^{+1}$  if present may be precipitated by the reagent keeping palladium in solution by cyanide.

#### 52. Bismuthiol II as an Analytical Reagent. Part IV: Estimation of Platinum Metals.

ANIL KUMAR MAJUMDAR AND MADAN MOHAN CHAKRABARTY, Calcutta.

Bismuthiol II has been found to be effective reagent for the estimation of palladium in presence of  $\text{Ru}^{+3}$ ,  $\text{OsO}_4^{-2}$ ,  $\text{Os}^{+4}$ ,  $\text{Ir}^{+4}$  and  $\text{Rh}^{+3}$  at a pH 6.6–8.0 with EDTA (disodium salt) as the masking agent and in presence of  $\text{Au}^{+3}$ ,  $\text{OsO}_4^{-2}$ ,  $\text{Os}^{+4}$  and  $\text{Ir}^{+4}$  at pH 6–7 with thiosulphate as the complexing agent.  $\text{Pd}^{+2}$  and  $\text{Pt}^{+4}$  can be separated from each other by precipitation in presence of a tartrate (pH 6–8), when  $\text{Pt}^{+4}$  remains in solution or in presence of a cyanide (pH 5–6.5) when  $\text{Pd}^{+2}$  and  $\text{Rh}^{+3}$  are left behind.

#### 53. Bismuthiol II as an Analytical Reagent. Part V: Estimation of Silver.

ANIL KUMAR MAJUMDAR and BHU RATNA SINGH, Calcutta.

Silver was estimated from a solution of high acidity to high pH as its Bismuthiol II complex having the composition  $\text{C}_6\text{H}_5\text{N}_2\text{S}_2\text{Ag}$ . The precipitate was found to be quite stable towards heat and light; the thermolysis curve showed the silver-complex to be stable up to about 280°C. With the reagent silver could be estimated in presence of nitric acid up to a maximum acidity of about 0.2N, sulphuric acid, acetic acid and ammonia up to about 1N and also in presence of Complexone III, citrate, tartrate and cyanide. With Complexone III, silver could be separated at a pH between 5 and 9 from almost all ions except  $\text{Hg}^{+2}$ ,  $\text{Hg}^{+3}$ ,  $\text{Pt}^{+4}$ ,  $\text{Pd}^{+2}$  and  $\text{Au}^{+3}$ ; the latter two could however be separated with cyanide and thiosulphate respectively as the complexing agents.

**54. Bismuthiol II as an Analytical Reagent. Part VI: Estimation of Thallium (I).**

ANIL KUMAR MAJUMDAR and BHU RATNA SINGH, Calcutta.

Thallium (I) forms the Bismuthiol II complex of composition  $C_4H_4N_2S_2Tl$ . At about  $10^\circ C$ , it is completely precipitated at high acidity as well at high alkalinity and the precipitate can be dried at any temperature up to  $250^\circ C$ . The complex is highly stable in presence of a tartrate or citrate, cyanide and complexone III and because of the unusual stability it can be estimated and separated from practically all ions. Bismuthiol II thus can be considered as a highly selective reagent for thallium (I) in presence of a mixture of cyanide and tartrate maintained at a pH between 7 and 9.

**55. Bismuthiol II as an Analytical Reagent. Part VII: Estimation and Separation of Silver from precious metals.**

ANIL KUMAR MAJUMDAR and BHU RATNA SINGH, Calcutta.

Silver can be separated as its Bismuthiol II complex from  $OsO_4^{-2}$ ,  $Os^{+4}$ ,  $Ir^{+4}$ ,  $Ru^{+3}$ ,  $Rh^{+3}$  with thiosulphate or complexone III as the masking agent at a pH between 5 and 9.  $Au^{+3}$  can be kept in solution only by thiosulphate at a pH 8-9 and cyanide complexes palladium at a pH of about 6. Separation from platinum in presence of a mixture of tartaric acid and complexone III is possible only to a limited extent.

**56. Analytical Chemistry of Nickel. Part I.**

J. S. DAVE and A. M. TALATI, Baroda.

$\alpha$ - $\beta$ -dioximes are known for their wide applications in the detection and estimation of Nickel. The oxime of  $\alpha$ -isonitroso-acetoacetanilide should show a similar behaviour and should work as an analytical reagent for the detection and estimation of Nickel. In the present paper preliminary investigations carried out to explore the usefulness of this reagent are discussed. Further work is in progress.

**57. Microestimation of Iodine.**

S. P. ROY CHOWDHURY and B. P. GYANI, Patna.

The methods available for microestimation of iodine have been critically examined. The limitations of indicator methods (Starch and  $CCl_4$ ) are discussed. The methods are found to be divisible into three broad classes according to range of concentrations coverable, namely 1000-50  $\mu g$ , 50-5  $\mu g$  and less than 5  $\mu g$  per 50 c.c. From the practical point of view the latter two ranges only are important and the methods available have been investigated in some detail, particularly the iodate intermediate method and the catalytic reduction methods ( $Ce^{++++} \rightarrow Ce^{+++}$ ). Both permanganate and bromine may be used for oxidation of iodide to iodate but the latter is preferable. In either case, a number of conditions (duration of oxidation, concentration of the iodide and other salts, amount of acid or alkali present, etc.) must be carefully observed. With proper precautions the accuracy is  $\pm 4\%$  in the range 200-5  $\mu g$  iodine/50 c.c. We found that the catalytic reduction method can cover the range 0.1 to 0.01  $\mu g$ /10 c.c. directly, the accuracy being 2-3%. The reduction is strongly dependent on temperature and ionic strength of the solution. There is no interference by  $Fe^{+++}$ , urea,  $CCl_3COOH$ ,  $Cu^{++}$  and creatinine, zinc chloride, but low values are obtained when fluorides are present. It is not practicable to replace KCNS by  $\alpha$ - $\alpha'$  dipyridyl, or  $FeSO_4$ -KCNS by ascorbic acid-2:6 dichlorophenol indophenol.

**58. The separation of Beryllium from Iron, Aluminium and Titanium by Ion Exchange and its application to the analysis of Beryl.**

M. S. VARDE and V. T. ATHAVALE, Bombay.

A new ion exchange method is proposed for the separation of Be from Al, Fe, Ti, Ca and phosphate, by preferentially adsorbing it on cation exchange resin Amberlite IR-120, after complexing the other ions with EDTA and  $H_2O_2$ . The successful application of the method to the analysis of beryls is demonstrated.

**59. On the Chromatographic Separation of Inorganic Anions on Specially prepared Calcium Sulphate Sticks.**

BINAYENDRA NATH SEN, Burdwan.

Calcium sulphate in the form of specially prepared sticks as short adsorbent columns have been found of much promise in effecting quick separation of inorganic ions (Sen, B. N., *Z. anorg. Chem.*, 268 (1952), 99; *Anal. Chim. Act.*, 12 (1955), 154) and a dozen cation groups have been successfully separated on the calcium sulphate body (ibid). The method is being extended to the separation of anions. Successful separation of  $PO_4^{3-}$ - $HPO_4^{2-}$ ,  $AsO_4^{3-}$ - $AsO_3^{3-}$ ,  $AsO_4^{3-}$ - $HPO_4^{2-}$ ,  $AsO_3^{3-}$ - $HPO_4^{2-}$ ,  $S_2O_3^{2-}$ - $CNS^-$ ,  $Fe(CN)_6^{4-}$ - $CNS^-$ ,  $Fe(CN)_6^{3-}$ - $CNS^-$ ,  $Fe(CN)_6^{4-}$ - $Fe(CN)_6^{3-}$ ,  $MnO_4^{2-}$ - $Cr_2O_7^{2-}$  and  $C_6H_5COO^-$ - $C_6H_5(OH)COO^-$  have been effected.

**60. Ethyl dithiocarbamate as an Analytical Reagent.**

BINAYENDRA NATH SEN, Burdwan.

The action of ethyl dithiocarbamate, which is instantly formed by the action of carbon disulphide on ethylamine at room temperature and can be stocked without vitiable deterioration, on the different metallic ions in the common analytical scheme has been studied with a view to replacing hydrogen sulphide. The study so far made show that precipitation occurs instantly or almost instantly and precipitates of well-defined colours and defined characteristics in acidic, weakly acidic and alkaline media are obtained at the ordinary temperature. The final colour of precipitates are in most cases similar to those obtained with hydrogen sulphide but there are discernible intermediate shades of colour and particle size before the final change which seem helpful for identification of the ions. Contrary to hydrogen sulphide characteristics, the precipitates in certain cases are soluble in excess of the reagent and this behaviour appears to favour conclusions. With proper control of conditions and pH, there is possibility to separate cations in groups. Characteristics of  $Pb^{2+}$ ,  $Hg^{+}$ ,  $Ag^{+}$ ,  $Hg^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Cu^{2+}$ ,  $As^{3+}$ ,  $Sb^{3+}$ ,  $Sn^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Mn^{2+}$ ,  $Zn^{2+}$ ; have been included in the list. The reagent speaks of promise.

**61. Investigations on 'Active Iron', Part II—Techniques employed in the study of reactivity.**

G. V. L. N. MURTY and T. R. RAMASWAMI, Jamshedpur.

An apparatus in which active iron, in the form of a deposit on metal foil, can be made to react with water or a solution of sodium citrate and the evolved gases accurately measured at atmospheric pressure over water, has been designed.

An elegant and rapid dichromate method for the volumetric estimation of iron in the presence of a large excess of sodium citrate is described.

**62. Relative Strengths of Acids in Water and Glycolic Solvents.**

C. KALIDAS, Calcutta.

Relative strengths of some acids have been studied in ethylene glycol-isopropyl alcohol (1:1) from potentiometric titration curves and compared with their strengths in water. A reversal of acid strengths has been observed in a number of cases. Thus, citric acid is found to be much weaker than formic acid in this medium, though the former is nearly eight times stronger than the latter in water. Salicylic acid appears to be much weaker than monochloro acetic acid in glycolic solvents, though they are nearly of equal strengths in water. These apparent anomalies presumably occur as a result of formation of hydrogen bonds between the hydroxyl groups in glycol and the hydroxy acids (citric and salicylic).

**63. Glycolic titration of Acid Mixtures.**

C. KALIDAS, Calcutta.

Glycolic solvents have been found to be suitable for analysis of some acid mixtures for which aqueous titration is not applicable. Thus it is not possible to estimate trichloro acetic acid in presence of acetic or monochloro acetic acid by potentiometric titration in water, only one inflexion being obtained corresponding to the total acids. When the same titration is done in Ethylene glycol-isopropyl alcohol (1:1) with sodium hydroxide in the same solvent as the base, two inflexions were observed, the first one corresponding to that of trichloro acetic acid and the second one corresponding to monochloro acetic acid. Thus it is possible to estimate both the constituents in a single titration. However, when the mixture is titrated with sodium acetate in the same solvent only one inflexion is observed corresponding to that of trichloro acetic acid.

Some dibasic and polybasic acids were also titrated in glycolic solvents with sodium hydroxide. But only one inflexion was obtained for oxalic, sulphurous and citric acids though sulphuric acid gives two.

**64. Mercurimetry I. Analysis of Sugars.**

G. R. SOMAYAJULU, Calcutta.

A simple and an elegant volumetric method of estimation of sugars has been found in the oxidation of sugar, say glucose by alkaline potassium mercury iodide and estimating the amount of alkali consumed during such oxidation, by titration with any standard mineral acid. The method has been found to yield excellent results in the case of glucose, lactose, maltose and fructose.

**65. Determination of Water in Acetic Acid with Acetic Anhydride and Aniline.**

MIHIR NATH DAS, Calcutta.

A method has been developed for determination of small amounts of water in acetic acid (0.1-0.5%) by utilising the acid catalysed reaction between acetic anhydride and water. A standard solution of acetic anhydride in acetic acid containing N/1000 perchloric acid is used as the reagent. This is standardised by allowing an aliquot part to react with a known amount of aniline and then estimating the unreacted aniline with a standard solution of N/10 perchloric acid in glacial acetic acid, using methyl violet as indicator. Water in acetic acid is estimated by allowing it to react with a known volume of the standard acetic anhydride solution and then estimating the unreacted anhydride with aniline as above. The accuracy is  $\pm 1\%$ .

**66. Oxidation of mixtures of Oxalic and Citric Acids.**

N. N. SHARMA AND R. C. MEHROTRA, Meerut and Lucknow.

Wilkinson and coworkers (1934) described a method of analysing mixtures of oxalic and citric acids by first determining the total acidity of the mixture and then the total reducing power with respect of ceric sulphate solution. The method was, however, empirical. It has been shown in the present communication that in dilute acidic solutions, citric acid consumes sixteen equivalents of ceric sulphate, but in the presence of concentrated sulphuric acid and chromium ions as catalysts citric acid consumes eighteen equivalents of ceric sulphate and is quantitatively oxidised to carbon dioxide and water. Oxalic acid, however, under both the conditions requires only two equivalents of ceric sulphate and is oxidised quantitatively to carbon dioxide and water. The observed difference in the titra value of ceric sulphate for the same volume of the mixture of acids, therefore, is equivalent to 1/9th of the amount of citric acid present in the mixture. The method has been shown to give quite satisfactory results in the mixtures of two acids even when their concentrations were varied within wide limits.

**67. Estimation of Ethyl and Isopropyl Alcohols in a mixture.**

K. C. GROVER and R. C. MEHROTRA, Lucknow.

It has been shown in the present investigation that alkaline hypobromite oxidises ethyl and isopropyl alcohols quantitatively as below:—

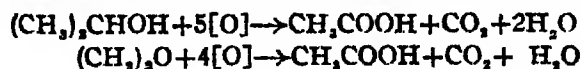


A combination of the above two oxidimetric procedures has been found to give satisfactory results in the analysis of mixtures of the two alcohols which could be analysed chemically till now by processes involving quantitative distillation only.

**68. Estimation of Isopropyl Alcohol and Acetone in mixture.**

K. C. GROVER and R. C. MEHROTRA, Lucknow.

A. C. Neish described a method for the analysis of mixtures of isopropyl alcohol and acetone. Isopropyl alcohol was first oxidised quantitatively to acetone by chromic acid and then the total acetone was determined by microdiffusion method. It has been found in the present investigation that on oxidation of the mixture with alkaline hypobromide, the following quantitative reactions occur:



Thus, a combination of the quantitative oxidation of the mixed solution by chromic acid and alkaline hypobromite separately can be utilised for finding the components individually present.

**69. Solubility of Lithium Phosphate in alcoholic media.**

K. N. VISHWESHWARAI AH and C. C. PATEL, Bangalore.

In the estimation of lithium as lithium phosphate, using  $\beta$ -diethyl amino ethyl alcohol phosphate reagent in presence of 60% ethyl alcohol, it was found that there was an error of  $\sim 0.35$  mg. of lithium for every 50.0 ml. of solution employed.

as precipitating medium. It was, therefore, necessary to determine the solubility of lithium phosphate in alcoholic media. To determine the solubility of the difficulty soluble lithium phosphate in different alcoholic media, the spectrophotometric method was employed. The solubility values were computed from the amount of phosphorus determined spectrophotometrically. For this purpose, the phosphate was converted to phospho-molybdic acid and reduced by amidol reagent to give a soluble blue complex having the absorption maximum at 720 m $\mu$ . Solubility of lithium phosphate has been determined at various temperatures. The apparatus employed for the determination of the solubility at higher temperatures (up to 68°C.) is described.

**70. Estimation of Fluorine in microgramme quantities—a modified procedure.**

G. V. L. N. MURTY, T. S. VISWANATHAN and V. RAMAKRISHNA,  
Jamshedpur.

A procedure is described for the estimation of Fluorine in microgramme quantities by the steam-distillation of the samples with sulphuric or phosphoric acid. Traces of the acid carried over are precipitated from the distillate as silver or barium salts, in order to eliminate their interference in the subsequent titration for fluorine. The results obtained compare favourably with those of the conventional perchloric acid method. By avoiding the latter, the present method offers the advantage of both safety and simplicity.

**71. On Some Physico-chemical Properties of Isonicotinyl-Hydrazonium-p-Aminosalicylate and a Method for its assay.**

NIITISH ROY CHOWDHURY and U. P. BASU, Calcutta.

Several antibacterial agents have recently been found effective against *M. tuberculosis*. But most of them are being found to form resistant strains and as such combination therapy is being preferred (cf., *Med. Res. Council, Brit. Med. J.*, 1955, *i*, 435). It is being further noticed that a salt formed by the molecular combination of the antitubercular drugs P.A.S. and Isoniazide, is effective in a much lower concentration (Clegg, *Brit. Med. J.*, 1955, *ii*, 1004; Guha, Ray and Bardhan, *J. Ind. Med. Assoc.*, 1956, in press). For this characteristic as well as for the other physiological properties of isoniazide noticed by Mandel *et al.* (*Proc. Soc. Expt. Biol. Med.*, 1956, *91*, 404) and Hughes *et al.* (*Amer. Rev. Tuberc.*, 1954, *70*, 266), a physico-chemical study of this Isonicotinyl-Hydrazonium-p-Aminosalicylate seemed to be of considerable significance.

The ultraviolet spectrum of the compound has been studied in solution at different pH values and it appears that the salt breaks down into its components at pH 6.0. No other changes were noticed on heating the compound at 37.5°C in solution at different pH. An aqueous solution of molecular proportion of isoniazide and P.A.S., shows the same Extinction-wavelength curve as the molecular compound itself.

The above observation led us to undertake the assay of the components of the salt, and it is being noticed that each part (P.A.S. as well as isoniazide) undergoes reaction with bromine in the customary way and this is being further found to be a measure of its quantity. A method for its assay, based on the above has been recorded.



**72. Estimation of Thiocyanates in presence of Thiocarbamides or vice versa.**

R. D. GUPTA, Pilani.

In presence of thiocarbamides, thiocyanates could not be determined, using Volhard's method; since silver nitrate forms complexes of varying compositions with thiocarbamides.

Use of alkaline copper sulphate, not only replaces the costly cadmium sulphate preferred by Williams (J.S.C.I., 1939, 58, 77-79T) but it affords a convenient method for the estimation of thiocarbamides as well.

The mixture is desulphurized by boiling with alkaline copper sulphate solution. The filtrate after acidification with con. nitric acid is estimated for thiocyanic acid, using Volhard's method.

The precipitated copper sulphide, freed from cupric oxide, is dissolved in 30% boiling nitric acid. Nitric acid is driven off, as usual, by evaporating repeatedly with dil. sulphuric acid. The residue is extracted with hot water. From the weight of copper, observed, the corresponding amounts of thiocarbamides are calculated. Mostly theoretical results were obtained.

**73. Volumetric Estimation of Thiourea.**

S. N. BANERJEE, Kharagpur.

C. Malir (Z. anal. Chem., 117, 91-4, 1939) has utilized the  $\text{KBrO}_3$ -KBr oxidation of thiourea to disulphide for the determination of the former. In an attempt to estimate thiourea in presence of mercuric chloride, the above method has been repeated and its conditions modified. It has been found that, for the estimation of 10 ml. of approximately 0.2N thiourea solution with standard bromate-bromide mixture,\* a slow titration at room temperature in a total volume of about 200 ml. containing 15 ml. of 18N sulfuric acid and 10 ml. of 1% potassium iodide solution gives an accurate, sharp end-point in presence of starch as indicator.

The effects of sulfuric acid and potassium iodide has been studied in the estimation of thiourea in presence of varying amounts of mercuric chloride, and an optimum experimental condition has been obtained.

This problem has been undertaken in order to study the phase equilibria of the system "thiourea-mercuric chloride-water", which is now in progress.

**74. A New Technique for the Detection of Damaged Sheep-wool.**

S. K. MITRA and B. M. DAS, Madras.

A new technique is presented for the determination of damaged sheep-wool by microscopical examination.

**75. Application of nonaqueous titration technique to the Chrome solutions containing Organic Acids and Salts.**

Y. NAYUDAMMA, K. S. JAYARAMAN and D. RAMASWAMY, Madras.

The application of nonaqueous titration technique to the determination of weak acids and their salts present in basic chrome liquors was attempted. The principle involved in this method is to precipitate chrome from chrome liquors containing organic acids and their salts by the addition of NaOH. The precipitate



is filtered off and the filtrate containing sodium salts is evaporated and the evaporated mass is dissolved in the nonaqueous medium of glycol-butanol-benzene mixture and titrated with a standard acid potentiometrically. This method gives good results for the determination of total organic acids and salts present in the liquor but the method fails where acids and salts that form stable chelate complexes with chrome are present.

## PHYSICAL CHEMISTRY

### 76. Boiling Point and van der Waals Volume.

G. R. SOMAYAJULU, Calcutta.

It has been shown (Somayajulu, Indian J. Phys., 30, 258, 1956) that the boiling point in any sequence of similar molecules is a linear function of the summation of the effective atomic numbers of the atoms in the molecule. It has been also shown that the covalent atomic surface area ( $R_v^2$ ) and the van der Waals volume ( $R_v^3$ ) are directly proportional to the effective atomic number of the element in any particular group of the periodic table. It follows from the above relationships that the boiling point would be linearly related to the surface area and also to van der Waals volume in any sequence of similar molecules. Somayajulu and Palit (Indian J. Phys., 30, 262, 1956) have reported the linear relationship between boiling point and surface area. The other relationship that is one between boiling point and van der Waals volume may be expressed as  $T_b = a \sum R_v^3 + b$  where  $T_b$  is the boiling point,  $R_v$  is the van der Waals radius,  $\sum R_v^3$  stands for the summation of the van der Waals volumes of all the atoms constituting the molecules and  $a$  and  $b$  are constants for any particular sequence of similar molecules. The relationship has been tested to be applicable to the sequence of molecules consisting of halogens and interhalogens of the AB type. In the case of halides of the general formula RX, where R is any particular atom or group of atoms and X is any of the halogen atoms, the same relationship holds if the sum of the van der Waals volumes of the halogen atoms in  $RX_n$  is used.

### 77. The Effective Atomic Numbers and the Physical Properties of the Elements.

G. R. SOMAYAJULU, Calcutta.

In continuation of our previous report (Indian J. Phys., 30, 258, 1956) of the effective atomic numbers of some elements, we report from similar considerations the effective atomic numbers of a large number of elements here. The effective atomic number  $Z'$  is equal to the atomic number  $Z$ , minus a constant  $S$ , characteristic of the element. In the following Table are given the  $S$ -numbers of a large number of elements.

*S-numbers of a large number of elements*

Elements					S-number
H—Mn	...	...	...	...	0
Ga—Tc	...	...	...	...	13
In—Ce	...	...	...	...	23
Hf—Re	...	...	...	...	37
Tl—U	...	...	...	...	47

**78. Molecular Weights of Liquids and Gases from Dry and Wet Bulb Temperatures.**

A. K. MUKHERJEE, Jodhpur.

From thermodynamic considerations the following equation has been deduced.

$$C_p(T-T_w) = L \cdot M_l \cdot e_w / M_g (p - e_w)$$

where  $C_p$  = Specific heat (per gm.) of the dry gas at constant pressure.

$T$  = Temperature of the gas blown.

$T_w$  = Temperature recorded by wet bulb thermometer.

$L$  = Latent heat of evaporation per gm. of liquid.

$M_l$  = Molecular weight of the liquid.

$M_g$  = Molecular weight of the dry gas.

$e_w$  = Saturation vapour pressure of the liquid at  $T_w$ .

$p$  = Pressure of the gas blown.

If the gas is dry air, we get

$$M_l = \frac{28.966 \times 0.240 \times (T - T_w) \times (p - e_w)}{L \cdot e_w}$$

Since other terms are measurable by suitable methods, we can determine molecular weight from this equation.

Similarly if water is used as the liquid wetting the thermometer, we get

$$M_g = \frac{18.02 \times e_w \times L}{(p - e_w) \times C_p (T - T_w)}$$

Since  $C_p$  can be measured by suitable method,  $e_w$  and  $L$  are available in the literature, and  $p$ ,  $T$  and  $T_w$  can be obtained during the experiment, molecular weight of the gas can be determined by this equation.

**79. On the relation between the Stability Constants of Metal Chelates in solution and the Electronegativity of their metal components.**

K. A. VENKATACHALAM and M. B. KABADI, Bombay.

The earlier work on the relation between the stability constants of metal chelates and complexes in solution, and the fundamental properties of their metal components, is reviewed. It is shown, using data reported in literature for about 25 ligands, that for the chelates of the doubly charged first transition series metals, with a given ligand,  $\log. K_1$  where  $K_1$  is the first stability constant, plotted against the sum of the first and second ionization potentials ( $I_1 + I_2$ ) of the gaseous atoms, yields better straight line, than the other plots, viz.,  $\log. K_1$  against electronegativity ( $x$ ) of the metal component or  $\log. K_1$  against  $I_2$ . A new relation, plot of  $\sqrt{\log. K_1}$  against  $x$ , is shown to yield straight lines, as good as, if not better than the  $\log. K_1$  against ( $I_1 + I_2$ ) plot, for the same series. It is shown that  $x^2$  is approximately proportional to ( $I_1 + I_2$ ), and on these grounds, a value of 1.57 is suggested for the electronegativity of  $Fe^{11}$ , the earlier values being 1.65 and 1.7. It is also shown, how the straight line plots of  $\log. K_1$  against  $x$ , can be justified on a semi-quantitative basis.

**80. Extraction of  $Hg^{11}$  ions using Thenoyl-Trifluoroacetone as Chelating Agent.**

R. G. DESHPANDE and HARI D. SHARMA, Bombay.

The effect of  $Hg^{11}$  ion and TTA concentrations on the distribution coefficient  $D_w$  in the two phases at different pH values has been studied during an investi-

gation of the extraction of  $\text{Hg}^{II}$  ions using  $\text{Hg}^{203}$  as tracer. The equilibrium constant for the reaction is

$$K = \frac{DM[\text{H}_{\text{aq}}]^n}{[\text{HTTA}_{\text{org}}]^n}$$

where  $DM$  = distribution coefficient of the metal ion  $M^{n+}$  in the two phases. The value of  $n$  has been found to be 1, indicating that the species extracted into the organic phase are hydroxy complexes of mercury with TTA, or that the species  $\text{Hg-O-Hg}^{++}$  react with TTA forming  $\text{Hg}_2\text{-O-(TTA)}_2$ . The  $D_M$  decreases with increasing  $\text{Hg}^{II}$  ion concentration indicating greater polymerisation in the aqueous than in the organic phase.

#### 81. Effect of Neutron Irradiation on Butyl Bromides.

A. R. GUPTA and HARI D. SHARMA, Bombay.

The organic yields for  $n\text{-C}_4\text{H}_9\text{Br}$ ,  $\text{sec-C}_4\text{H}_9\text{Br}$  and  $\text{iso-C}_4\text{H}_9\text{Br}$  have been determined in presence of 1 mole per cent elemental bromine, the values being respectively 30%, 32% and 95%. The difference in the organic yields of  $n\text{-C}_4\text{H}_9\text{Br}$  and  $\text{sec-C}_4\text{H}_9\text{Br}$  is of the same order of magnitude as has been reported for  $n\text{-C}_3\text{H}_7\text{Br}$  and  $\text{sec-C}_3\text{H}_7\text{Br}$ . The greater organic yield for  $\text{iso-C}_4\text{H}_9\text{Br}$  has been attributed to its structure. The organic yield for  $\text{ter-C}_4\text{H}_9\text{Br}$  could not be obtained as it hydrolyzes rapidly in presence of aqueous extracting solution.

The scavenging effect due to  $\text{Br}_2$  and  $\text{I}_2$  has been investigated. The latter does not act as a scavenging agent in the case of butyl bromides.

#### 82. Kinetics of the Isothermal Annealing in Neutron-irradiated Potassium Trioxalato Cobaltate $[\text{K}_3\text{Co}(\text{C}_2\text{O}_4)_3] \cdot 3\text{H}_2\text{O}$ .

JAGDISH SHANKAR and V. G. THOMAS, Bombay.

The kinetics of annealing have been studied at several temperatures. They follow a first order process at lower temperatures. At higher temperatures there is perhaps interference from the decomposition products of the complex.

#### 83. Kinetics of the Isothermal Annealing in Neutron-irradiated Tris-Glycine CO (III).

JAGDISH SHANKAR, AMAR NATH AND S. B. SRIVASTAVA, Bombay.

The kinetics of 'healing' is governed by two or more first order processes indicating the presence of several types of damage-centers. The activation energy associated with the slowest process is found to be about 19 Kcal per mole.

#### 84. Study of Szilard-Chalmers Reaction in 'Open-type' Complexes of Cobalt.

JAGDISH SHANKAR and AMAR NATH, Bombay.

It is observed that the 'open-type' complexes of cobalt generally have a low 'retentive value' and that the magnitude of thermal and  $\gamma$ -irradiation annealing is of a low order. In general, the damage does not yield to annealing and perhaps it can be explained as due to the fact that the recoil atom experiences little hindrance from the 'ligand skeleton'.

**85. Study of the Kinetics of Isotopic Exchange of Tris-Nitroso- $\beta$ -Naphthol CO (III) with Cobaltous Acetate in Pyridine.**

JAGDISH SHANKAR, AMAR NATH and S. B. SRIVASTAVA, Bombay.

Quantitative studies of the isotopic exchange were carried out at three temperatures and the activation energy determined.

The half-time of exchange ( $t_{1/2}$ ) in pyridine is found to be proportional to the reciprocal of the total concentration of the exchanging atoms and hence favour the "atom transfer" mechanism for the exchange.

The studies seem to indicate that the bonds of the central cobalt atom in the complex possess partial 'ionic character'.

**86. Single Crystal Rotation Photographs about three Primitive Axes from a single setting on a Weissenberg Camera.**

JAGDISH SHANKAR and P. G. KHUBCHANDANI, Bombay.

A modification in the Unicam Weissenberg Camera has been made and described in this paper so that, in the case of single crystals belonging to any crystal class other than the triclinic, rotation (or oscillation) photographs can be taken about all the three principal axes from a single setting of the crystal. The photographs are taken on a plate camera and the parameters calculated from the layer lines.

**87. Cell Dimensions and Space Group of Uranium Tetrafluoride.**

JAGDISH SHANKAR and P. G. KHUBCHANDANI, Bombay.

Uranium tetrafluoride was prepared by fluorination of ammonium diuranate. Emerald coloured crystals sublimed off from the reaction tube.

From the powder and single crystal rotation and Weissenberg photographs the following data has been obtained :—

$$\begin{array}{lll} a_0 = 12.73 \text{ \AA} & b_0 = 10.75 \text{ \AA} & c_0 = 8.43 \text{ \AA} \\ \beta = 126^\circ 20' & \text{Space group } C_{2h}^* (C2/c) & \end{array}$$

**88. Use of Sodium Versenate for Eliminating Lead Error in Pol Determinations.**

K. S. G. DOSS and VISHNU, Kanpur.

In the determination of the polarisation of sugar house products, it is usual to clarify the solutions using lead salts. The latter are however found to influence the rotation in virtue of their forming complexes with sugars with a modified rotatory power. The error is considerable when levulose is present. It is shown that versene (sodium salt of ethylenediaminetetracetic acid) can be used to eliminate the lead error.

**89. Effect of thymol blue, night blue and methyl violet on the capacity of the dropping mercury electrode.**

S. L. GUPTA, Kanpur.

The effect of thymol blue, night blue and methyl violet has been investigated on the dropping mercury electrode capacity. At pH 5.6 and 1.0 thymol blue

system is distinguished by the occurrence of a main peak and a satellite. The cause of the satellites has been discussed. It has been seen that although the night blue is showing sufficiently high depression of capacity due to adsorption, the desorption peaks are very small. The nature of the peaks caused by thymol blue, night blue and methyl violet has also been discussed.

#### 90. Effect of methylene blue on the capacity of the dropping mercury electrode.

K. S. G. DOSS and S. L. GUPTA, Kanpur.

The effect of methylene blue under different conditions of pH, concentration and frequency of the a.c. ripple used has been investigated on the capacity of the dropping mercury electrode. All the peaks caused by methylene blue at different pH values have been interpreted as due to the reduction of the methylene blue, as indicated by the comprehensive study of the peaks. The halt at about 0.58 volts at pH 5.8 is due to desorption which develops into a satellite peak if potassium nitrate is used as indifferent electrolyte. It is found that the peak at 1.35 volts at pH 12.3 first increases with increase in concentration and then diminishes at still higher concentrations. The cause of this has been discussed. The effect of frequency reveals that the reduction reactions involved are rather slow.

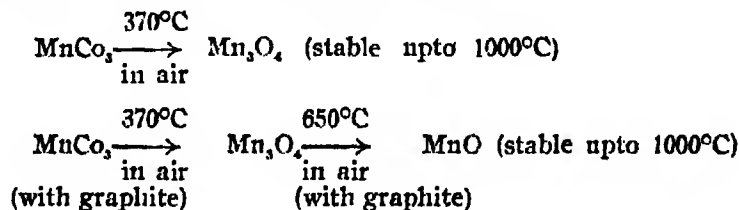
#### 91. Studies on the Oxides of Manganese.

K. S. IRANI, A. P. B. SINHA, N. R. SANJANA and A. B. BISWAS, Poona.

The decomposition of manganese carbonate has been followed upto 1000°C by differential thermal analysis and the products obtained at different stages of heating have been analysed by X-ray diffraction.

Manganese carbonate decomposes at 370°C giving a strong endothermic peak and the product is found to be  $Mn_2O_3$  which is stable upto 1000°. However, when these experiments are carried out with the sample taken in a graphite lined container, it is found that the endothermic peak at 370°C is reproduced forming  $Mn_2O_3$ . On further heating an exothermic peak appears at 650°C and the product formed is stable upto 1000°C and found to be MnO, indicating the reduction of  $Mn_2O_3$  to MnO, presumably due to the graphite lining of the container.

The reaction steps may be represented as :



#### 92. Differential Thermal Analysis of the System $ZrO_2$ .

(Miss) S. KAMESWARI and S. K. BHATTACHARYYA, Kharagpur.

The thermal behaviour of zirconium oxide prepared by adding different alkalis to zirconium nitrate and zirconium sulphate has been studied by the method of Differential Thermal Analysis (D.T.A.) and attempts have been made to correlate the data with those of X-ray diffraction studies, surface area measurements and catalytic activity.

All the gels show an endothermic peak of large magnitude at about 50°-300°C, due to loss of water present in the gel. The exothermic peak obtained at temperature of 400-470°C in all cases, is due to the formation of crystalline monoclinic zirconium oxide from the amorphous form.

The complete expulsion of water takes place at a temperature of about 350-400°C and this corresponds to the temperature at which zirconium oxide exhibits maximum catalytic activity.

### 93. Differential Thermal Analysis of the System, $\text{Cr}_2\text{O}_3\text{-ZrO}_2$ .

(Miss) S. KAMESWARI and S. K. BHATTACHARYYA, Kharagpur.

Mutual protective action against crystallisation has been observed in the system  $\text{Cr}_2\text{O}_3\text{-ZrO}_2$  by the method of Differential Thermal Analysis (D.T.A.).

The chromic oxide gel exhibits a low temperature endothermic peak due to the loss of water from the gel and a large exothermic peak at 395°C (range, 370°-410°C) due to the amorphous gel transforming to crystalline form. The zirconium oxide gel exhibits an endothermic peak due to the loss of adsorbed water between 50°-350°C and an exothermic peak at 430°C (range, 350-440°C) due to formation of monoclinic  $\text{ZrO}_2$  from the amorphous form.

Gel mixtures prepared by adding ammonium hydroxide to the respective nitrate solutions show an endothermic peak of large magnitude extending from a temperature of 50°C to 300°C. This peak is due to the loss of adsorbed as well as rigidly bound water from the hydrous zirconium and chromic oxides.

The gel mixture of the composition  $\text{Cr}_2\text{O}_3\text{:ZrO}_2=40:60$  (molar) seems to exhibit the maximum protective action against crystallisation. The peak temperature of the exothermic peak is as high as 820°C (range 700°-880°C). This composition may correspond to enhanced surface properties and catalytic activity.

### 94. Differential Thermal Analysis of Iodide Catalysts.

DHARAM VIR, K. S. DE and S. K. BHATTACHARYYA, Kharagpur.

Differential thermal analysis (D.T.A) of nickel iodide, cobalt iodide and ferrous iodide catalysts, unsupported or supported on kieselgullur or silica gel, has been carried out. All the samples show two endothermic peaks, one of a small magnitude at about 60°C. due to the loss of physically adsorbed water, and the other at about 150°C. due to the dehydration of the hydrate of the iodide. The latter peak, which is of a large magnitude, is followed by an exothermic peak due to the evolution of iodine above 250°C.

D.T.A. of iodide catalysts, which have been previously used for the synthesis of glycollic acid at high pressures from formaldehyde, carbon monoxide and water, show another peak of an exothermic nature before the evolution of iodine from the sample takes place. This peak, which is absent in the case of fresh catalyst samples, may be due to the formation of a water-insoluble compound during the process of catalysis.

Formation of a new compound which undergoes an exothermic change at 95°C. was indicated by the differential thermal analysis of catalyst samples used for the synthesis and then treated with water in the form of a 38.4% formaldehyde solution. It was found that an exothermic peak of a large magnitude occurs at this temperature and masks the first endothermic peak. The results with cobalt, nickel and iron catalysts were basically similar in character.

**95. Kinetic Study of the Thermal Decomposition of Gaseous Zinc Dimethyl.**

LOURDU M. YEDDANAPALLI and R. GANESAN, Madras.

The thermal decomposition of zinc dimethyl in the gas phase has been investigated over the pressure range 20–160 mm. Hg. and within the temperatures 305.5–387.0°C. The overall kinetic order of the reaction is one and its apparent energy of activation, 27.0 kcal mole<sup>-1</sup>. By carrying out the decomposition in packed reaction vessels with known surface to volume ratio, it has been possible to evaluate the relative proportions of the homogeneous and heterogeneous parts of the reaction, and to determine their energies of activation as 29.3 and 12.0 kcal mole<sup>-1</sup> resp. Further, the average heterogeneous part of the reaction in the normal unpacked vessel over the temperature range 305.5–387.0°C has been found to be about 12.8% and the homogeneous part, 87.2%, on the basis of which the calculated activation energy for the normal reaction turns out to be 27.1 kcal mole<sup>-1</sup> in agreement with the experimentally determined value of 27.0 kcal mole<sup>-1</sup>. The observed first order rate constant, the rather low overall activation energy and the reaction products, viz., methane, ethane, ethylene, and hydrogen definitely indicate the reaction to be a complex one, for the elucidation of which further work is in progress.

However, as far as methane, the major component of the reaction products, is concerned, a mechanism is proposed in which the main step for the production of methane is  $\text{CH}_4 + \text{Zn}(\text{CH}_3)_2 = \text{CH}_4 + \text{Zn}(\text{CH}_3)_2$ , the activation energy of which is found to be 12.3 kcal mole<sup>-1</sup>, comparable with 11.14 kcal mole<sup>-1</sup> reported for  $\text{Hg}(\text{CH}_3)_2$  and 14 kcal mole<sup>-1</sup> for  $\text{Cd}(\text{CH}_3)_2$ .

**96. Thermal Decomposition of Carbon Monoxide, Paraformaldehyde and Formaldehyde Solutions at High Pressures.**

DHARAM VIR and S. K. BHATTACHARYYA, Kharagpur.

In view of the increasing use of iodide catalysts of nickel, cobalt and iron for carboxylic acid synthesis from carbon monoxide, investigations have been carried out for the determination of the extent to which carbon monoxide decomposes to carbon dioxide and carbon in the presence of these catalysts. It is found that the effect of increased pressure or increased temperature is to cause a higher conversion of carbon monoxide to these products. Thus, 9.1% of carbon monoxide are converted to carbon dioxide at 230°C and 6,000 psi, against 7.7% at 200°C and 5,390 psi and 4.0% at 200°C and 1,750 psi, when  $\text{NiI}_2 \cdot \text{SiO}_2$  (89:11) is used as a catalyst, in a residence period of two hours. Lesser conversions are obtained with cobalt iodide-silica and ferrous iodide-silica catalysts. The conversion to carbon dioxide in uncatalysed decomposition at 230°C and 6,000 psi is only 2.5% in 2 hours.

Decomposition studies have also been carried out on paraformaldehyde and a 38.4% solution of formaldehyde containing 6.5% of methanol, both of which are used in the high pressure synthesis of glycolic acid. Paraformaldehyde decomposes to carbon monoxide, methane, methanol, formic acid and hydrogen. The solution gives carbon dioxide in place of carbon monoxide. In all cases, higher temperatures lead to increased decomposition, but, while an increased nitrogen pressure leads to somewhat higher yields of the products of paraformaldehyde decomposition, the effect observed with formaldehyde solution is the reverse of this observation. The order of catalytic activity is the same as with carbon monoxide.

**97. Miscibility of Glycerol with different Natural oils at different temperatures.**

R. BASU ROY CHOUDHURY, Calcutta.

The present worker determined the miscibility of glycerol in cocoanut, groundnut, hydrogenated groundnut, sesame and sardine fish oil in presence of 0.1% NaOH on basis of fat at various temp. to find out whether the nature of the fat and its fatty acid composition affects the miscibility. From the results obtained, it is clear that the miscibility of glycerol in oil depends upon

- (1) Temperature
- (2) Molecular weight of the fat; and to a little extent,
- (3) On the unsaturation of the fat (especially at higher temp.).

Oils of comparable molecular weights yield similar results as shown by groundnut and sesame oils. Cocoanut oil having lower molecular weight fatty acids is more miscible with glycerol. The effect of unsaturation is not very marked. At higher temp. the solubility slightly increases with increase in unsaturation.

**98. Viscosity of some Oil Mixtures.**

B. P. GYANI and M. MURARI, Patna.

The viscosities of pure argemone oil and the oil from *caesalpinia digyna* (teri) have been measured at different temperatures. The energy of activation of viscous flow for each has been calculated. Viscosities of the mixtures of argemone oil—Castor oil, hydrogenated castor oil—cocoanut oil and liquid paraffin-kerosene have been measured at 40°C. Viscosities of mixtures of argemone oil, hydrogenated cocoanut oil, kerosene, diesel oil and benzene with an acetylated castor oil have also been measured at the same temperature. There is always a simple relation between viscosity and composition of the mixtures as previously described. Although acetylation increases the molecular weight of castor oil, it reduces the viscosity to about half.

**99. Studies on the Viscosity of the oil of Moringa Concanensisim.**

R. D. PATEL, K. C. PATEL and S. A. PATEL, Bombay.

The viscosity of the oil of Moringa Concanensisim is determined in various solvents such as :—benzene, toluene, xylene, cyclohexane, n-butanol and heptane. In each case the viscosity determined is expressed in centistokes and centipoises at  $30^{\circ} \pm 0.01^{\circ}\text{C}$ . Specially designed pyknometer and viscometers (Ubbelohde suspended level type) are used. The general working of the oil-solvents mixtures are analogous. There is a remarkable influence on the values of viscosity of the oil-solvent mixtures at 40-60% concentration of the oil. Each solvent has specific influence on the values of viscosity.

**100. Viscosity of Solutions of Potassium Chloride in Methyl-alcohol water mixture at 35 C.**

K. SINGH, P. K. DAS and D. PATNAIK, Cuttack.

The study of the viscosity of solutions of electrolytes in mixed solvents has been undertaken with a view to verify the applicability of Jones Dole equation to such cases and also to explore the nature of B. The dependence of B on the composition of the solvent would furnish a direct proof to the effect that B depends



on the nature of the solvent. The present investigation comprises the study of the viscosity of solutions of potassium chloride in 10, 20, 30, 40 and 50 per cent composition by weight of methyl alcohol-water mixture. The concentration of the electrolyte varies from 0.01 to 0.20N. The experimental data fit in well with Jones-Dole equation

$$\eta/\eta_0 = 1 + A\sqrt{C} + BC$$

Upto 30% composition, B does not show any significant and systematic change with the composition of the solvent as has been noticed in case of dioxan-water mixtures (communicated to J. Ind. Chem. Soc.). The systematic change in B with the increase in the percentage of methyl alcohol for 40 and 50% mixtures clearly point out to the fact that B depends on the nature of the solvent. Further we are of opinion that the association reaction taking place in the sphere of solvation determines the magnitude of B. Viscosity data of the type under question are lacking in literature for advancing any theory at present regarding the factors precisely influencing the magnitude of B.

#### 101. Effect of Viscosity on the quenching of Fluorescence.

G. C. BHATTACHARYA and S. N. MUKHERJEE, Jadavpur, Calcutta.

The viscosity effect on the quenching of fluorescence of anthracene solution in benzene using nitrobenzene as a quencher has been studied. The viscosity has been changed by the addition of liquid paraffin. With the same concentration of the fluorescer (e.g.  $10^{-4}$  M) the quenching effect with different quencher concentrations and varying viscosities of the medium was studied. It has been observed that the quenching diminishes with increasing viscosity with the same quencher concentration. The ratio  $I_0/I$  plotted against  $\frac{1}{\eta}$  was found to be linearly related at low viscosities but such linearity does not hold at high viscosities. These observations are in conformity with the work of Sveshnikoff (Acta Physico-chemica, vol. 3, p. 257, 1935). The values of average life period  $\tau_0$  of the fluorescer molecules at different viscosities have also been calculated. It has been found that as the viscosity increases the values of  $\tau_0$  also increases.

#### 102. Potentiometric Studies of Strong Electrolytes.

S. K. K. JATKAR and VIJAYA JOGAL, Poona.

Study of the complex formation and double salt formation in solutions of lanthanum, cerium, thorium and lead nitrates with lithium, sodium, potassium, ammonium and rubidium nitrates, and nitric acid, of mercuric chloride with potassium and ammonium chlorides and of barium chloride with potassium chloride by precision potentiometric technique has indicated strong inflections at stoichiometric ratios:

1, 2, 3,.....8, 18, 36, 54, 100, 110, 128, 136 and 172.

These results would indicate the formation of a superlattice structure of ions in solutions.

#### 103. Titration curve of Brittle Mica.

R. P. MITRA and B. K. SHARMA, Delhi.

Brittle mica,  $\text{Ca Al}_2 (\text{Al}_2\text{Si}_2) \text{O}_{10} (\text{OH})_2$ , was finely ground and suspended in water. Potentiometric titration of this suspension, which was quite stable, gave a titration curve showing two definite inflexions. The base combining capacities

calculated from the two inflexions were as 1:2, which seemed to suggest that the two inflexions indicated a stepwise neutralisation of the two structural hydroxyl groups in the brittle mica, subject to the condition that these groups were accessible to the titrant base. Titration of the 'hydrogen form' of the brittle mica, obtained by replacing the exposed calcium ions by hydrogen ions, gave a titration curve which showed an additional inflexion at a lower pH. This inflexion indicated the neutralisation of hydrogen ions acquired by the surface in exchange for the exposed calcium ions. The quantity of these hydrogen ions was found to be equal to that of the hydroxyl groups reacting with the base, as would also be expected from the structural formula of brittle mica.

#### 104. Determination of the dissociation constants of Gallic Acid at different temperatures.

N. A. RAMAIAH and S. L. GUPTA, Kanpur.

With a view to understand the contribution of gallic acid, one of the chief constituents of sugar-cane juices, to the acidic nature of this last, it appeared desirable to determine the dissociation constants  $K$  of the acid at different temperatures ( $T$ ) in the range 300–360° A. This was achieved by titrating potentiometrically the acid solution of a known strength against standard sodium hydroxide solution in an inert gas atmosphere. The value of  $K$  obtained at 303°A was  $3.84 \times 10^{-5}$ . Increase in temperature decreased the value of  $K$ . It obeyed roughly an equation.

$$K = a + bT + cT^2$$

where  $a$ ,  $b$  and  $c$  are constants.

#### 105. Studies on the dissociation constants of weak bases from optical absorption measurements.

J. DUTTA and H. C. CHAKRABARTY, Calcutta.

Dissociation constants of Barberine and related alkaloids which are weak bases have been determined from the measurements of the optical densities of their solutions of different pH values in the ultraviolet region.

The familiar equation,

$$\text{pOH} = \text{pK}_b + \log \frac{D_x}{D_m}, \text{ has been used.}$$

$\alpha$  the degree of dissociation has been obtained from the relation  $\alpha = \frac{D_x}{D_m}$ , where

$D_m$  is the optical density of the solution of the alkaloid in completely ionised condition, i.e. acidified solution.  $D_x$  is the optical density of the buffered solutions of the alkaloid.

The optical densities are measured with a Beckmann D. U. Spectro-photometer and pH values of the buffers are measured by a Beckmann pH meter.

$\text{pK}_b$  values of Barberine, Dihydrobarberine, and Neprotine were found to be 5.86, 6.04, 5.81 respectively by this method.

#### 106. Studies in complex formation with Sulphosalicylic Acid, Potentiometric and conductometric study of Beryllium-sulphosalicylate complex. I.

RAJENDRA SEN SINGH and SATYA PRAKASH, Allahabad.

Potentiometric and conductometric study of complex beryllium sulphosalicylate have been made. Mixtures containing beryllium sulphate and sulphosalicylic acid in the ratios of 1:1, 1:2 and 1:4 respectively, were titrated with

alkali and the changes in the hydrogen ion concentration and the specific conductivity were plotted against the equivalents of alkali added. From the graphs, it has been shown that beryllium forms two types of complexes with sulphosalicylic acid, (i) a 1:1 complex when the ratio of the reactants is 1:1 and (ii) 1:2 complex when the ratio is 1:2 or more. Both the complexes are stable, as the beryllium is not precipitated by alkali even at high values of pH. It has further been shown that in both the complexes, the coordination takes place between the oxygen atoms of hydroxyl and carboxyl groups.

This has further been confirmed with our studies with disodium sulphosalicylate ( $\text{NaO}_2\text{S}-\text{C}_6\text{H}_3-\text{COONa}$ ). A mixture of beryllium and disodium sulphosalicylate has a pH lower than both that of beryllium or disodium salt alone, the pH curve gives an inflexion at one equivalent of alkali which clearly indicate that the phenolic hydrogen is displaced during complexation.

**107. Studies on complex formation with Sulphosalicylic Acid, Potentiometric, conductometric and colorimetric study of Uranyl-sulphosalicylate complex. II.**

RAJENDRA S. SINGH and SATYA PRAKASH, Allahabad.

Potentiometric, conductometric and colorimetric studies of complex formation between uranyl and sulphosalicylate have been made. Mixtures containing uranyl and sulphosalicylic acid in the ratio of 1:1 and 1:4 respectively were titrated with alkali, and the changes in pH, specific conductivity and colorimeter readings were plotted against the number of equivalents of alkali. From the graphs, it has been shown that uranyl forms only one complex with sulphosalicylic acid, the ratio being 1:1. The complex gives a maximum colorimeter reading, when three equivalents of alkali have been added (pH 4.3). The inflexion in the pH and sp. conductivity curves and maximum colorimeter reading all occurring at three equivalents of alkali show clearly that the mixture behaves as if it were of a tribasic acid. This can only be possible if the phenolic hydrogen is displaced during complex formation.

The studies with disodium sulphosalicylate and uranyl show clearly the displacement of phenolic hydrogen. A mixture of uranyl and disodium sulphosalicylate has a pH lower than uranyl or disodium salt alone. When titrated with alkali the mixture behaves like that of a monobasic acid. It is clear that during the complex formation, the phenolic hydrogen is displaced, and the coordination takes place between the oxygen atoms of hydroxyl and carboxyl groups.

**108. Studies in complex formation with Sulpho-Salicylic Acid, Potentiometric and conductometric study of Aluminium-Sulphosalicylate complex. III.**

RAJENDRA S. SINGH and SATYA PRAKASH, Allahabad.

The complex formation of aluminium (III) with sulphosalicylic acid has been investigated. Mixtures containing aluminium chloride and sulphosalicylic acid in the ratios of 1:1, 1:2, 1:3 and 1:4 were titrated with alkali respectively. Blank titration of sulpho-salicylic acid and aluminium chloride were also done. The results were represented graphically, abscissa representing the equivalents of alkali added per gram ion of hydrogen of the acid. The acid gives an inflexion at two equivalents of alkali, showing that the acid is dibasic. The 1:1 mixture gives a inflexion at three equivalents of alkali and the aluminium of the complex is not precipitated at all, which shows the formation of a complex. However, a crystalline white precipitate is obtained at pH values 4.0-6.8, which may be some hydrolysis product of the complex formed. The 1:2, 1:3 and 1:4 mixtures give evidences for the formation of a complex, the ratio of metal to

acid being 1:2. The aluminium of the complex is not at all precipitated, which shows the greater stability of the complex formed. The excess sulphosalicylic acid remains ionised in solution.

Experiments with disodium sulphosalicylate and aluminium (III) show that the phenolic hydrogen is displaced during the complex formation and that the coordination takes place between the oxygen atoms of the phenolic and carboxyl groups, even in acidic medium.

#### 109. Manganese Acetate complex in aqueous solution.

S. K. SIDDHANTA and S. N. BANERJEE, Kharagpur.

In this paper the value of the thermodynamic constant  $K$ , for the equilibrium



has been determined by studying the equilibrium hydrogen ion concentration in a mixture of equimolar amounts of manganese chloride and acetic acid. The composition of the complex formed has been found by the application of "Job's method of continued variation" using increase of hydrogen ions due to complex formation, as the index property. Assuming complete dissociation of manganese chloride, the value of the thermodynamic dissociation constant  $K$ , for the ion  $\text{MnAc}^+$ , has been found out from the value of the equilibrium hydrogen ion concentration of the above mentioned solution mixtures by the application of the "law of mass action," taking into account the activity coefficients of the individual ions, calculated from the ionic strength of the solution mixture, applying the "Debye Hückel limiting law".

The value of  $K = 60.3 \times 10^{-3}$  is found in this paper, and there appears to be no previous work on the determination of this constant in case of manganese acetate.

#### 110. Studies on the behaviour of Cuprous Chloride in Potassium Chloride and Hydrochloric Acid solutions.

S. ANWAR ALI and WAHID-U-MALIK, Aligarh.

Investigations have been carried out to determine the complex ion formation between cuprous chloride and hydrochloric acid and cuprous chloride and potassium chloride in the aqueous and solid phases. An indirect method to determine concentrations in solid phase has been employed due to rapid oxidation of cuprous chloride. The concentrations of cuprous chloride and potassium chloride determined by purely analytical methods have been confirmed by using Colorimeter and Flame Photometer.

The two systems have been studied by drawing rectangular curves. In the case of hydrochloric acid, complexes like  $\text{H}_2\text{CuCl}_2$  and  $\text{H}_3\text{CuCl}_4$  are formed in liquid phase while  $\text{HCuCl}_2$ ;  $\text{H}_2\text{CuCl}_3$ ;  $\text{H}_3\text{CuCl}_4$  are formed in the solid phase. For potassium chloride only the existence of one complex ( $\text{K}_2\text{CuCl}_4$ ) in the liquid phase could be formed while in the solid phase two complexes ( $\text{KCuCl}_2$ ;  $\text{K}_2\text{CuCl}_4$ ) have been obtained. Surface phenomenon seems to play some role in complex formation with KCl.

#### 111. Conductometric studies on the reaction between Mercurous (Mercury) and Potassium Ferrocyanide.

RAM SAHAI SAXENA (Kota, Rajasthan).

In continuation of our previous publication (Jour. Indian Chem. Soc. 31, p. 157, 1954) on the potentiometric studies of this reaction, this paper contains our

observations by conductivity measurements. The reaction between  $\text{Hg}_2(\text{NO}_3)_2$  and  $\text{K}_4\text{Fe}(\text{CN})_6$  has been studied by conductometric titrations between the reactants at several concentrations, in aqueous and alcoholic solutions, both by the direct and the inverse methods. The conductometric titration curves yield three distinct breaks corresponding to the formation of  $\text{K}_2\text{Hg}_2\text{Fe}(\text{CN})_6$ ;  $(\text{Hg}_2)_2\text{Fe}(\text{CN})_6$  and also an additive complex having the composition  $2\text{K}_2\text{Hg}_2\text{Fe}(\text{CN})_6 \cdot \text{Hg}_2(\text{NO}_3)_2$ . The observed titre values are slightly lower than the calculated points of equivalence for the formation of above compounds which gradually approach each other in presence of increasing amounts of alcohol. This discrepancy has been explained on the basis of adsorption of  $\text{Hg}_2^{++}$  and  $\text{Fe}(\text{CN})_6^{4-}$  ions by the precipitate. The formation of the compound  $(\text{Hg}_2)_2\text{Fe}(\text{CN})_6$  as observed from potentiometric titrations (loc. cit) has been confirmed by conductivity results.

#### 112. Potentiometric studies on the composition of Cobaltferrocyanide complex.

RAM SAHAI SAXENA, Kota (Rajasthan).

The composition of Cobaltferrocyanide has been studied by potentiometric titrations between  $\text{Co}(\text{NO}_3)_2$  and potassium ferrocyanide applying ferricyanide-ferrocyanide electrode both by the direct and reverse methods. The end point, calculated from  $\max. \Delta E / \Delta C$  and observed from sharp inflection in curves, corresponds to the formation of a double salt having the composition  $4\text{Co}_2\text{Fe}(\text{CN})_6 \cdot 3\text{K}_4\text{Fe}(\text{CN})_6$  with either of the substance used as the reagent in titration. The curves have a regular shape; there is a sharp jump in potential at the end point and the results are accurate and reproducible. The addition of alcohol and electrolytes like  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{K}_2\text{SO}_4$  does not appreciably change the end point except that the jump in potential decreases in their presence. In presence of 30% alcohol the observed titre values closely approach the calculated points of equivalence for the formation of the above compound.

The potentiometric results support the investigations of I.V. Tananaev and M. I. Levina (Zhur. anal. Khim., 3, 31, 1948, cf. C. A. 42, 6257f) by electrochemical methods which suggest the above composition. There is no evidence of the formation of  $\text{K}_2\text{CoFe}(\text{CN})_6$  as suggested by Treadwell and Chervet (C.A. 17, 38) nor of  $\text{Co}_2\text{Fe}(\text{CN})_6$  as observed by Kosaku Masaki (Bull. Chem. Soc., Japan, 7, 188, 1932).

#### 113. Reduction of Potassium Dichromate by Potassium Ferrocyanide in presence of Sulphuric and Hydrochloric Acids.

B. P. GYANI, Patna.

The reduction of potassium dichromate by ferrocyanide ions in presence of varying quantities of sulphuric and hydrochloric acids has been studied potentiometrically at room temperature. An inflexion in the titration curve corresponding to six moles ferrocyanide per mole dichromate is obtained in both the cases if the acid concentrations are 2 to 3 normal sulphuric acid or about quarter to one normal hydrochloric acid. At other concentrations the inflexion is either less definite or shows a departure from the correct value. These titrations have a special significance since the colour changes at the end point are vague although they are quite definite in the permanganate-ferrocyanide titrations.

#### 114. Reaction between Ferric Chloride and Ammonium Thiocyanate.

B. P. GYANI and MISS R. MISRA, Patna.

The reaction between ferric chloride and ammonium thiocyanate in dilute solutions has been further studied. The red substances produced are reduced at the cathode in electrolysis or by nascent hydrogen in neutral or acid solutions.

(Al-Hg in water or Zinc in HCl). Cataphoresis in an agar-agar jelly shows definitely that the red particles carry negative charges. There are indications from experiments on diffusion in variously treated paper strips that the red substance may be fairly polydisperse.

**115. Reaction of Formic acid with Keratin fibres, studied by Physico-chemical methods. Part I: Goat Hair.**

C. S. NARWANI and H. K. PAREKH, Bombay.

On treating goat hair with 99-100% Mercks Formic acid at room temperature for various intervals, 24 to 144 hours and subsequent soaking in water for 44 hours, the elasticity decreases as shown by stress-strain graphs, though there is no swelling as shown by measurement of the diameter. The strength of the hair decreases with increase in time of treatment with Formic acid. It is observed that treatment of the goat hair with Formic acid at room temperature, for 24 hours makes it suitable for spinning into a smooth surfaced thread without much decrease in strength.

On soxhleting the hair with 99-100% Mercks Formic acid for six hours, 17-45% go in solution which is found to be non-colloidal as shown by viscosity measurements. On diluting this solution with equal amount of water, there is precipitation of dark brown residue and formation of yellow aqueous solution. On evaporating the Formic acid solution to dryness on steam-bath, a dark brown residue is obtained, which is partly soluble in water; the aqueous yellow solution on treatment with silver-ammonical solution gives on warming in water bath a black precipitate, indicating the presence of sulphhydryl group. Quantitative estimation of cystein produced by the reduction of cystine of hair with Formic acid has been carried out.

**116. Studies in the formation of Trivalent Manganese.**

DHIRENDRA NATH CHAKRAVARTY and SATYESHWAR GHOSH, Allahabad.

Formation of trivalent manganese has been observed during the oxidation of bivalent manganese by hexavalent chromium. The oxidation has however been found to be a reversible process. The region of maximum absorption of the individual reactants and products have been determined using Unicam SP 500 Spectrophotometer. The rate of formation of tripositive manganese has been followed by Klett-Summerson's Photo-electric colorimeter. The colorimeter was previously standardised for the purpose. The velocity and equilibrium constants of the reaction have been determined and the heat of reaction worked out to be -5.484 Kcals.

**117. Studies in the Metathesis of Beryllium Chloride and Sodium Silicate solutions.**

KANHAIYA LAL YADAVA and SATYESHWAR GHOSH, Allahabad.

To a beryllium chloride solution, sodium silicate solutions of different compositions have been progressively added and conductometric and potentiometric observations have been made at every stage of the addition. It has been concluded from the observations that at first hydrochloric acid produced in the system from the hydrolysis of the beryllium chloride reacts with the sodium silicate and then direct reaction between unhydrolysed beryllium chloride and sodium silicate takes place producing two kinds of silicates. In the pH curve,

there occurs an inflexion beyond the equivalent value, suggesting generation of silicic acid either by the action of hydrochloric acid present in beryllium chloride on sodium silicate or the hydrolysis of beryllium silicate produced in the system. Thus the product obtained in the metathesis consists of a mixture of silica, beryllium hydroxide and two silicates of the metal. It has been further concluded that the hydrolysis of beryllium chloride is not an instantaneous process.

**118. A study of different methods of dispersion for the measurement of particle size distribution of clay.**

B. N. SAMADDAR GURUDAS MANDAL and D. LAHIRI, Calcutta.

Various methods of dispersion for the determination of particle size distribution of clays were studied. Samples of Rajmahal clay, Bankura clay and Ball clay were selected and particle size distribution was measured by the Andreasen pipette method for the coarser fraction and centrifugal method for the finer fraction. Clay was dispersed by the following methods:—

(a) Raw clay together with sodium pyrophosphate as an electrolyte shaken for (i) 4 hours (ii) 8 hours.

(b) Purified H-clay shaken with the electrolyte for 4 hours.

(c) Raw clay ground in a ball mill and then dispersed by shaking with the electrolyte for 4 hours.

The following observations were made:—

(a) Decrease of particle size with increase of shaking period was not appreciable.

(b) Purified H-clay showed increased fineness.

(c) Grinding had less effect on finer particles where as particle size of Bankura clay was reduced to a considerable extent. It appears that white-burning Bankura clay which does not find much use in ceramics, can be made useful by fine grinding.

**119. Sedimentation Volume as a Criterion of the Stability of Suspensions.**

MARJORIE J. VOLD, Bangalore.

It has long been recognised that unstable suspensions yield large sedimentation volumes because adhesion occurs on contact between particles and prevents their sliding over each other to achieve efficient packing. The present work analyses the problem of relating the observed volume to the magnitude of the inter-particle forces.

Elongated particles occupy a larger volume for the same number of contacts between particles. Likewise the compacting force on the sediment depends on the density difference. A criterion of stability based on relative sediment volumes is evolved after applying corrections for these factors, and applied to the relative stabilities of suspension of carbon black and lithium stearate in benzene.

**120. Ionization in Adsorbed Layers of Sodium Dodecyl Sulfate in Relation to Detergency.**

ROBERT D. VOLD and ACHYUT K. PHANSALKAR, Bangalore.

In an investigation of the factors important in the separation of solid soil from surfaces parallel studies have been made of the extent of the adsorption of sodium dodecyl sulfate on carbon black, the electro-phoretic mobility of the particles, and their extent of deposition on cotton (by a radio-tracer method) both in the presence and absence of auxiliary electrolyte.

The very large effect of small increases in surface ion concentration at very low concentrations in decreasing deposition of carbon on cotton is due to the mutual repulsion between the negatively charged surfaces. In the presence of auxiliary electrolyte this repulsion is lower for a given surface charge density, but the adsorption is increased, so that the two effects nearly balance each other, the actual deposition in the presence of added salt being only slightly greater or less than in its absence, depending on the concentration.

The magnitude of the zeta potential, which determines the repulsion, reaches a maximum value as detergent concentration is increased, while the extent of adsorption is still increasing quite rapidly. The surface charge needed to effect a given zeta potential, however, increases so rapidly as total concentration increases, that the data can only be accounted for by assuming that the degree of ionization at the surface increases as the extent of adsorption increases.

The data show that other factors in addition to the electrical repulsion are also important in determining the interaction between particle and surface.

#### 121. Studies in Colloidal silicates—Part I. Conductometric and potentiometric studies in the metathesis of Ferric Chloride and Sodium Silicates.

KANHAIYA LAL YADAVA and SATYESHWAR GHOSH, Allahabad.

When a sodium silicate solution is added to a ferric chloride solution a precipitate is obtained. On controlling the concentrations of the reacting solutions a sol may also be produced. Divergent views have been put forward regarding the formation of ferric silicate. This study has been taken in hand to throw light on the mechanism of the reaction.

To a ferric chloride solution, increasing amounts of sodium silicate have been added. At every stage of the addition of the silicate solution, conductometric and potentiometric measurements have been made. The electrical conductance first decreases then increases to a maximum and finally again drops to a minimum at the equivalent point. In dilute solutions or on longer ageing, the rise in conductance gradually disappears. The first fall in the conductance is due to neutralisation of hydrochloric acid produced as a result of hydrolysis of ferric chloride. The rise in conductance is accountable by the direct reaction between sodium silicate and unhydrolysed ferric chloride leading to the formation of ferric silicate, but the later decrease in conductance suggests a complex formation of ferric silicate in which sodium is also associated.

The pH curves are bi-logarithmic in nature, the inflexion occurring beyond the equivalent point. This suggests the separation of silicic acid either as a result of reaction of hydrochloric acid produced by the hydrolysis of ferric chloride with sodium silicate or hydrolysis of ferric silicate.

It is therefore concluded that the precipitated matter is a mixture of hydrous ferric oxide, silica, ferric silicate and a complex silicate associated with sodium.

#### 122. Studies in Colloidal Silicates—II. Conductometric and analytical studies of metathesis between Chloride of Barium and Strontium with Sodium Silicates.

KANHAIYA LAL YADAVA and SATYESHWAR GHOSH, Allahabad.

It has been concluded from the conductometric studies that progressive addition of a sodium silicate solution to a chloride of barium or strontium, the corresponding silicate is produced which hydrolyses in dilute solutions. The conclusion is supported by analytical data. It has been found that in initial stages of addition of sodium silicate to a fixed amount of the metallic chlorides, the precipitate contains high percentage of silica. The ratio of silica to metal in the precipitate tends to theoretical values as the amount of the sodium silicate



is increased. It may also be suggested that the metallic chloride first merely acts as coagulant for the highly polymerised silica anions in the sodium silicate and later on it reacts with the sodium silicate producing the corresponding silicate.

### 123. Studies in Colloidal Silicates—III. Studies in the metathesis of Chromium Chloride and Sodium Silicates.

KANHAIYA LAL, YADAVA and SATYESHWAR GHOSH, Allahabad.

To a chromium chloride solution, increasing amounts of sodium silicates have been added and specific conductance and pH measurements have been made as in previous papers. The conductance curve obtained with 1:3.2 sodium silicate first bends then rises upto nearly 2/3rd equivalent and finally again with another slope. This continues upto the equivalent point. Beyond this, it rises rapidly. The bend in the conductance curve occurs on account of neutralisation of hydrochloric acid present in the chromium chloride. The two breaks clearly indicate the formation of two different silicates of chromium with sodium silicate of 1:3.200 soda silica ratio.

When the sodium silicate of 1:4.266 soda silica ratio is used the first break disappears and the last break occurs ahead the equivalent point. This suggests that only one silicate is formed and the reaction is not stoichiometric. Inflexion in pH occurs beyond the equivalent value due to the generation of silicic acid either from the hydrolysis of chromium silicate or due to the action of HCl in the chromium chloride on sodium silicates.

### 124. Adsorption of Phosphate by Montmorillonite group of minerals.

P. R. SINHA, Calcutta.

A study of the interaction of phosphate with montmorillonite group of minerals reveals that the adsorption of phosphate by the minerals is a complicated affair which cannot be explained from consideration of ion exchange. Phosphate is adsorbed by replacement of OH groups on the edges of the particles but this adsorption is not anion exchange because the cations of the lattice *viz.*, Al, Fe, Mg, Ca, or Zn can fix phosphate by a process of chemical reaction and the low solubility of the compounds is the determining factor in such adsorption. Replacement of the adsorbed phosphate by oxalate or citrate brings out Al, Mg, etc., along with phosphate. Moreover, under favourable conditions such as low pH, high temperature, long period of contact, the interaction leads to degradation of the mineral on the surface and consequent increased adsorption. Comparing the different types of montmorillonites, such as Bentonite (Kashmere), Sanconite (Arkansas, U.S.A.), and Hectorite (California, U. S.A.), the susceptibility to degradation increases in that order. This is expected from consideration of their structures according to which the strain in the lattice due to isomorphous replacements increases in that order. Due to absence of any isomorphous replacement in the lattice of kaolinite, the mineral should be more stable than montmorillonites to the action of phosphate and this is actually observed.

### 125. Freezing points of Adsorbate Liquids.

BALWANT RAI PURI, D. D. SINGH and Y. P. MYER, Hoshiarpur.

Since capillary forces believed to be responsible for adsorption by porous bodies influence vapour pressures at curved surfaces, it follows that freezing points of the adsorbate liquids should be different from those in bulk. This affords means to check the theory of capillary condensation. Freezing point depressions

of benzene, dioxane, p-xylene and ethylene diamine, adsorbed on four different porous bodies, at different relative pressures corresponding to condensation in capillary pores of different radii, were, therefore, determined by measuring the equilibrium pressures of the systems at different temperatures and by plotting  $\log p$  Vs  $1/T$  curves to detect freezing points. The values were found to agree fairly well with those calculated from thermodynamic considerations based on the theory of capillary condensation. The results also indicate that the vapour pressure of the solid phase is not effected by capillary action while that of the liquid phase is altered in accordance with the Kelvin equation.

#### 126. Interaction of Charcoal with alkalies.

BALWANT RAI PURI, GURCHARAN SINGH and LEKH RAJ SHARMA,  
Hoshiarpur.

The authors regard base-adsorption by charcoal as a neutralising reaction on account of the presence of  $\text{CO}_2$  as a surface compound in its oxygen complex by virtue of which it behaves as a weak colloidal acid or 'acidoid' and undergoes surface ionisation in water yielding hydrogen ions directed towards the liquid phase. As evidence in favour of this view they studied extensively interaction of sugar charcoal evacuated at increasing temperature, with different alkalies, volumetrically potentiometrically and conductometrically. The titration curves gave sharp points of inflection and the amounts of the various alkalies neutralised were found to be fairly close to one another irrespective of their nature or the method of estimation employed. Also during the process hydroxyl and metallic ions were removed from solutions in equivalent quantities. Further, the decrease in the base-adsorption capacity, on evacuating at a particular temperature, was found to be almost equivalent to the amount of  $\text{CO}_2$  given out by the charcoal at that temperature. The  $\text{pK}$  value of the charcoal acidoid was also found to be quite close to that of carbonic acid.

#### 127. The influence of chemisorbed Carbon Monoxide on subsequent adsorption of Nitrogen on Cobalt powder.

V. SRINIVASAN, Bangalore.

Experiments were carried out to determine the effect of previously chemisorbed CO on subsequent adsorption of  $\text{N}_2$  at  $-191^\circ$  on a pure metallic surface, viz., cobalt powder. The following observations were made: (1) The presence of a film of CO on the surface of the adsorbent suppressed its adsorption of  $\text{N}_2$  at  $-191^\circ$ ; the extent of suppression is almost constant (0.25 c.c.) and did not vary when films of CO ranging from 1.0 to 2.5 cc., were involved. (2) It was not therefore possible to make any distinction between weakly and strongly chemisorbed CO, the gas retained on the surface of cobalt powder on desorption being dependent on the temperature of desorption. (3) The desorption of CO increased progressively with temperature; there was no temperature range in which the desorption is constant and so no differentiation is possible between the two types of adsorption.

#### 128. A study of the Surface-Tension of the systems :—Water—0.2 N Sodium-Salts of the fatty acids—Butanol-1 in presence of free acids and free Sodium-hydroxide.

K. N. MEHROTRA, Lucknow.

The Surface-Tension of neutral soap as well as of acid soap solutions in presence of different concentrations of butanol-1 has been determined. It has been concluded

that upto 50% butanol-1 concentrations the hydrophilic oleomicelles exist and above 50% butanol-1 concentration, lipophilic hydromicelles are formed. It has also been observed that the addition of free sodium hydroxide to soap solutions, decreases the surface-tension of the solutions and this decrease in surface-tension is due to the fact that the excess of alkali suppresses the hydrolysis.

**129. Effect of fatty acids on the solubilization of alcohols in aqueous solutions of soaps.**

K. N. MEHROTRA, Lucknow.

The Solubilizing capacity for the solubilization of alcohols is in the order : 100% neutralized acid > 75% > 50% > 25% neutralized acid.

The tendency to form gel or highly viscous solutions increases as the number of Carbon Atoms in Soap increases. The temperature at which gel transforms into clear solution also increases with the increase in concentration of sodium hydroxide as well as with the increase in number of carbon atoms in soap or alcohol. The capacity to solubilize alcohols decreases as the length of acid chain in soap increases.

From the viscosity measurements, it has been concluded that two types of micelles are formed.

The solubilizing capacity of acid and neutral soaps of caprylic, capric and lauric acid for the solubilization of butanol-1, 3-methyl-butanol-1 and hexanol-1 has been determined and it is in the order : Sodium laurate > sodium caprate > sodium caprylate.

Butanol-1 is solubilized to the same extent in 75% and 100% neutralized acid systems, whereas 3-methyl-butanol-1 and hexanol-1 are solubilized to a larger extent in the neutral soaps than in the acid soaps.

Viscosity results reveal that two types of micelles are formed.

**130. Relation of time of Gelation with concentration of sols.**

KANHAIYA LAL YADAVA, SALIL KUMAR BOSE and SATYESHWAR GHOSH, Allahabad.

Many empirical equations relating the time of set and concentration of sols or coagulants have been suggested. Here an equation relating time of set with the concentration of material forming gel has been obtained.

When colloidal particles approach one another they pass through a number of energy changes as a result of the electrostatic repulsion and the van der Waal's attraction. For highly solvated colloids, the attractive forces are considerably modified and partially discharged particles, do not actually coalesce but their Brownian movement is considerably damped. Thus a loose structure is formed in which colloidal particles unlike those in coagulation, retain their separate entity. It has been further assumed when a certain number of colloidal particles, irrespective of the concentration of the sols, lose their Brownian movement forming a loose structure. Smoluchowski's equation for coagulation has been used to obtain the relation

$$\frac{1}{K C^2 t} + \frac{1}{C} = \text{Const.}$$

where 'K' is a constant, 'C' the concentration of the sol and 't' the time of set.

**131. Magnetic Study of Iron Glass.**

BHUPATI KUMAR BANERJEE, Calcutta.

Magnetic study of different types of iron glasses has been made to elucidate the relationship between the colour and the constitution of iron glass. The investigation is extended to several types of glass series such as borate, silicate, etc. prepared in different founding conditions like neutral, reducing and oxidising atmospheres.

A systematic study of the possible state of colouring constituent has been made with particular reference to the existing theories about the origin of colour in iron glass.

It is observed that iron exists in two or more forms of different valency states with different types of electronic bonding and the relative amounts of these forms are conditioned by the glass composition, method of preparation and thermal history.

**132. Studies in the recovery of Uranium from Sulphate Leach solutions by Anion exchange in the presence of Phosphate.**

M. V. NAYAK and D. V. BHATNAGAR, Bombay.

At present uranium from sulphuric acid leach solutions resulting from the treatment of low grade ores is generally recovered by the ion exchange process. Leach solutions obtained from low grade Indian ores are usually found to contain phosphate in the range 10-25 g as  $P_2O_5$  per litre due to the dissolution of apatite present in the ores. The effect of phosphate on the adsorption and elution of uranium is studied using synthetic solutions. It has been found that the phosphate considerably increases the capacity of a bed for uranium in the absence of ferric iron which complexes with phosphate and thus decreases this effect. Further, change in pH from 1.0 to 1.85 has little effect on the capacity of the resin in presence of phosphate whereas in its absence it has considerable influence.

Efficiency of elution of uranium from the loaded resin bed with chloride-hydrochloric acid or nitrate-nitric acid mixtures has been found to fall off markedly in presence of phosphate ions. Increase in acid concentration of the eluent has been found to improve the efficiency of elution. A scheme for recycling of the eluate after stripping off uranium is given. The tolerance limit of phosphate in this recycled eluent has been found to be about 2g  $P_2O_5$  per litre.

**133. Determination of the stability constants of Anionic complexes by the method of Ion-exchange.**

ASIT KUMAR RAY and PRIYADARANJAN RAY, Calcutta.

It has been shown that ion exchange reactions, in combination with radio-tracers, can be used to measure the dissociation constants of complex ions. Such investigations are of particular interest inasmuch as the remarkable separations of cations obtained with cation exchangers, depend on the equilibria existing among the cations, the complexing anions and the cation exchanger.

The ion exchange method depends primarily on the fact that the quantity of a cation bound to a definite amount of cation exchanger at equilibrium,  $MR$ ,

is proportional to the concentration of free ions (M) in the solution over a wide range of concentration:—

$$\frac{MR}{(M)} = \lambda_0 = \frac{a_0 v}{(100 - a_0)g}$$

where  $\lambda_0$  = a constant (for exchange in absence of chelating agent),

MR = moles of metal bound by unit weight of cation exchanger,

M = concentration of the metal ion in solution at equilibrium,

$a_0$  = per cent of total metal used which is bound to exchanger,

$100 - a_0$  = per cent of total metal used which remains in solution,

v = volume of solution, and

g = weight of cation exchanger.

For the determination of  $\lambda_0$  values the following factors are considered:—

(a) a resin such as Amerlite IR 120, whose capacity was independent of pH over a wide range, was used and

(b) only 0.1% error was allowed in the determination of  $\lambda_0$  values.

In the determination of the stability of copper chloride anionic complexes by ion exchange method the distribution coefficient of cupric ion between the ion exchange resin and solution was determined under two different conditions as follows:—

(a)  $\lambda_0$ , the distribution coefficient in the absence of complexing agent (chloride),

(b)  $\lambda$ , the distribution coefficient in the presence of the complexing agent (chloride).

From those two values the value of Kc, the complexity constant, was determined from the equation:—

$$Kc = \frac{a.A}{\lambda_0[S - \frac{a}{\lambda_0}]}$$

where a = % of the cupric ion adsorbed by the exchangers at equilibrium,

S = % of the cupric ion which remains in solution,

A = Molar concentration of complex forming anion (here chloride ion),

$\lambda_0$  = the ratio a/S, when A is absent from the solution, i.e. the slope of the adsorption isotherm.

The values of the overall complexity constants determined were found to be of the following order of magnitude:—

$$Kc(\text{overall}) = 0.0215 - 0.098$$

for  $\text{Cu}(\text{H}_2\text{O})\text{Cl}_4^-$

and  $\text{CuCl}_4^-$  ions.

### 134. Cation exchange measurements in the solid phase.

A. CHATTERJEE, Calcutta.

Soils are capable of delivering nutrients or metal ions at a much lower moisture status than what is obtained in the pasty condition. Since exchange, (if any, in the air-dry state, for example, (but not strictly moisture free, for air-dry clay may contain 5-10% moisture) will be very small, it has been studied by using radioactive gold ions. For this purpose radioactive gold has been introduced as an exchangeable cation into the clay. The exchange of gold ion has been studied against Na- and Ca-clays by maintaining (i) one of the phases in the solid state and (ii) both the phases in the solid state. In (ii) exchange does take place but to a very small extent, whereas in (i) the exchange is quite appreciable. This information which is based on the counting of  $\beta$ -particles from radioactive gold is, no doubt, qualitative, but perhaps indicates the trend correctly.

**135. The phenomenon of Cation exchange in charcoal.**

BALWANT RAI PURI, GURCHARAN SINGH and LAKH RAJ SHARMA,  
Hoshiarpur.

Treatment of charcoal with alkalis involves the replacement of surface hydrogen ions by the metal cations which cannot be replaced even by prolonged leachings with water. However, these ions can be replaced by other cations by suitable treatments and thus charcoal can undergo base-exchange reactions like soils, zeolites, proteins etc. The order of replacing powers of the various cations appears to be  $H^+ > Al^{+++} > Ba^{++} > Ca^{++} > Mg^{++} > Na^+ > NH_4^+$ .

**136. Contribution of Structural Hydroxyl Groups to the Base Exchange Capacity of Montmorillonite.**

R. P. MITRA and HAKAM SINGH, Delhi.

A study has been made of the role of exposed structural hydroxyl groups in montmorillonite in determining the latter's base exchange capacity. A typical sample of the mineral, which was used for this purpose, had a base exchange capacity of 100 m.e. per 100 gms. as obtained on potentiometric titration of the hydrogen form. Acetylation with acetic anhydride in the presence of pyridine gave an acetylation value of 40 m.e. per 100 gms. Potentiometric titration of a neutral-salt extract of the acetylated material gave a titration curve which showed an inflexion corresponding to only about 60 m.e. per 100 gms. This result, taken with the acetylation value reported above, appears to indicate that, out of the total base exchange capacity of 100 m.e. per 100 gms., 40 m.e. are contributed by OH groups.

**137. Exchange of Phosphates adsorbed by clays for other Anions.**

A. CHATTERJEE, Calcutta.

Anion exchange measurements have been carried out with particular reference to phosphate ions, partly because it is important as a plant nutrient and partly because it has the peculiar property of becoming unavailable or fixed under certain conditions by the clays and clay minerals. Anion exchange resins saturated with hydroxyl, oxalate, citrate and fluoride ions are used for the exchange measurements. Hydroxyl, citrate and oxalate ions of the anionic resin exchange themselves for phosphate in varying extents but fluoride ion is almost incapable of releasing phosphate which may be due to the high pH of the clay suspension used in the experiment.

**138. Measurement of exchangeable ions in different affinity levels.**

A. CHATTERJEE, Calcutta.

It is known that the exchangeable ions are not of equal bonding energies. The nutrient ions present in the soil is supposed to be made available to the plant by means of an exchange process. In that case the availability will be influenced by the exchangeability of the different category of ions of the clays which is determined by their bonding energy to the clays. This difference in the exchangeability of a particular cation at different degrees of saturation has been demonstrated by allowing the heteroionic systems  $\begin{matrix} NH_4 \\ Ba \end{matrix}$  }-clay and  $\begin{matrix} NH_4 \\ Na \end{matrix}$  }-clay to equilibrate with the H-resin in cellophane bags. It is found that the cation

which is added first is more difficult to exchange for  $H^+$  ions than the one added next. The existence of 'loosely' and 'firmly' bound conditions of the same cation is thus clearly noticeable from the experimental data.

### 139. Conductometric and Electrometric studies of Ferric Succinate.

S. K. BOSE and S. P. MUSHRAN, Allahabad.

Ferric chloride and sodium succinate solutions interact to give a gelatinous precipitate, and at suitable concentrations produce a colloidal solution. Here we have investigated the precipitation effected by the progressive addition sodium succinate to a ferric chloride solution of different dilutions. The conductivity graph shows a slight fall at first, followed by a rise and then a sharp fall is obtained till the reactants are in equivalent amounts, after which it rises continuously. The first fall with a very small amount of sodium succinate is effected due to the neutralization of the free acid generated by the ferric chloride. Then the conductivity rises as is expected, due to the formation of more conducting sodium chloride obtained by this metathetic process. But the second and the sharp fall certainly leads to the conclusion that both sodium and ferric ions are carried down with the precipitate, possibly due to some complex formation till the equivalent amounts have been added.

It is concluded that the precipitate is a mixture containing hydrous ferric oxide, ferric succinate and also a complex compound formed with sodium succinate. The pH variation also shows a gradual rise, and is biogarithmic in nature. The point of inflexion is obtained at the equivalent concentrations of the reactants.

### 140. Studies in Ferric Succinate sols and gels. Pt. I—Viscosity study of Ferric Succinate sols.

S. K. BOSE and S. P. MUSHRAN, Allahabad.

Ferric Succinate was precipitated by the interaction of ferric chloride and sodium succinate. The precipitate thus obtained was washed thoroughly until it remained in a semipeptized form. It was subsequently dissolved in different amounts of succinic acid and thus three different samples of the ferric succinate sol with different purities were obtained. The sols thus obtained were stable transparent and red in colour and on the addition of suitable electrolytes set readily to transparent and stable jellies.

It has been observed that the viscosity of the sols depends upon their purity. Pure sols being more viscous than the impure ones. The results obtained for the measurement of the rate of flow through capillary at various pressures are very significant. It has been observed that the sols exhibit deviations from the Poiseuille's law for fluids. The rate of flow is not directly proportional to the shearing force so that the ratio of the pressure to the rate of flow does not remain constant, which should be the case for normal fluids. The deviations are more marked the greater the purity of the sol. The deviations have been explained on the basis of the existence of structuration in such colloidal systems and the development of the structural flow which replaces the well known normal 'Newtonian flow'. The greater the purity of the sol the greater is the 'structuration'. It has been further observed that as the sols are allowed to age the 'structuration' becomes more pronounced. The maximum ageing effect being observed in the sol of maximum purity. The existence of structurations and the development of the structural flow therefore greatly depends on the purity and age of the sols investigated.

**141. Studies in Ferric Succinate sols and gels. Pt. II—Study of the kinetics of sol-gel transformation.**

S. K. BOSH and S. P. MUSHRAN, Allahabad.

Three samples of ferric succinate sols of different purity were prepared according to the method described in Pt-I of this series. The sols yield stable and transparent jellies when coagulated with electrolytes like sodium chloride of suitable concentrations. It is observed that the kinetics of sol-gel transformation is governed by the equation  $\log \theta = A - BC$  where ' $\theta$ ' is the time of set and ' $C$ ' concentration of the electrolyte employed. The time of set is greatly influenced by the purity of the sol. Similar results are observed on the effect of age on these sols. Aged samples give gels more readily than the fresh ones. The results are explained on the basis of the existence of 'structurations' in such sols. It has been shown that gelation is closely related to the 'structuration' of the colloidal system. The 'structurations' make the colloidal particles stick together at several points forming loose net works leading ultimately to gel formation. When the structuration in a sol is less there is less tendency of the sol to yield gels. Structuration and gelation are, therefore, intimately related to each other.

**142. Setting of Hydraulic Limes and Natural Cements—Differentiation of Hydraulic and Puzzolonic Functions of Setting Characteristics.**

DHARAM VIR, Kharagpur and RAGHUBIR SINGH, Aunritsar.

A method has been developed to quantitatively evaluate the hydraulic and puzzolonic functions into which setting characteristics of hydraulic limes containing 15-30% aluminium silicate may be differentiated. A consideration of the nature of the curves obtained by plotting the unpenetrated distance,  $z$ , against the time period,  $\theta$ , in Vicat needle experiments indicates their conformation to the general equation:

$$\theta = a z^2 + b \sqrt{z}$$

Since the slope of each curve, given by its first differential

$$\frac{d\theta}{dz} = 2az + \frac{1}{2}b z^{-\frac{1}{2}}$$

passes through a minimum at the point of inflection,

$$\frac{d^2\theta}{dz^2} = 2a - \frac{1}{4}b z^{-\frac{3}{2}} = 0.$$

Hence,  $z = \left( \frac{b}{8a} \right)^{\frac{2}{3}}$  at the point of inflection. This point is indicative of what may be defined as the maximum set point. The coordinates of this point ( $\theta'$ ,  $z'$ ), which are uniquely determined by the constants  $a$  and  $b$ , are graphically evaluated by plotting  $\frac{\delta\theta}{\delta z}$  against  $\theta$  or  $z$ .

It is found that the puzzolonic-set characteristic function,  $\theta_1$ , and the hydraulic-set characteristic function,  $\theta_2$ , may be expressed in the form  $\theta = \theta_1 + \theta_2$ ,

$$\text{where } \theta_1 = az^2 \text{ and } \theta_2 = b\sqrt{z}$$

At the maximum set point,  $\delta\theta_1 = \theta_2$  and  $a\theta^3 = 0.1780b^4$ . The puzzolonic-set characteristic function and its hydraulic counterpart at the maximum set point are consequently determined by the independent variables  $a$  and  $b$ . These functions may numerically be evaluated by solving the general equation:

$$\theta = az^2 + b\sqrt{z}$$

for two sets of experimental values of  $\theta$  and  $z$  from a setting curve, preferably in proximity to the maximum set point.



Experimental values for these functions have been obtained in a number of cases. Under specified operating conditions, they may be related to the chemical composition of a particular series of hydraulic limes.

#### 143. Rhythmicity on Impregnated Filter-papers.

A. C. CHATTERJI and HARI BHAGWAN, Lucknow.

Rhythmicity has so far been studied with impregnated agar-agar, gelatin, starch or silicic acid columns. It has been found that strips of Whatman No. 1 filter paper partially impregnated with the precipitating agent along with or without colloid can also be used for obtaining rhythmic patterns. Thus an independent method for obtaining rhythmic precipitates on cellulose fibres with a technique very similar to ascending chromatography has been developed.

When 40%  $\text{Pb}(\text{NO}_3)_2$  is diffused through a 40% KI impregnated strip and the band of  $\text{PbI}_2$  is washed thoroughly with distilled water, good rings are obtained. Similarly under specified conditions rhythmic structures can be obtained by diffusing KI solution through  $\text{Pb}(\text{NO}_3)_2$  impregnated papers. When strips are impregnated with KI along with colloid such as agar-agar, gelatin or starch as fixary agent, rhythmic vertical bands are obtained at a much lower concentration; in these cases clear interspaces are obtained without washing the strip, whereas with aqueous solution alone washing is necessary.  $\text{KNO}_3$  if added to the diffusing cation has been found to have a marked effect in adding to the rhythmicity of  $\text{PbI}_2$  band.

#### 144. Solid state studies in the system $\text{Fe}_2\text{O}_3$ - $\text{U}_3\text{O}_8$ .

M. D. KARKHANAVALA, Bombay.

A study of the naturally occurring uranium bearing ferruginous ores has been made. It has been established that uranium occurs in association with the hematite and not with the magnetite portions. A sample of natural haematite containing 0.15%  $\text{U}_3\text{O}_8$  was found to occur in the metamict state, the reconstitution of which has been established by X-ray and differential thermal analysis methods. In order to establish—the nature of association of  $\text{U}_3\text{O}_8$  with  $\text{Fe}_2\text{O}_3$ , a study was made of six artificial mixtures, ranging from 0 to 1%  $\text{U}_3\text{O}_8$  by weight. Precision lattice determinations of these mixtures revealed the existence of a solid solution of  $\text{U}_3\text{O}_8$  in  $\gamma\text{-Fe}_2\text{O}_3$  upto at least 1%, the limits of the composition studied in the present investigation.

#### 145. The ternary system ammonium sulphate-ammonium nitrate-water at 30°C.

G. ARAVAMUDAN, Bangalore.

The phase relationships in the system ammonium sulphate-ammonium nitrate-water were worked out at 30° and the results plotted on the triangular diagram. The solid phases in the system were found out employing Schreinemaker's wet residue method as well as Hill and Ricci's algebraic extrapolation method. The saturation curve consists of four branches, the two belonging to the anhydrous salt components namely ammonium sulphate and ammonium nitrate and the other two due to the formation of double salts of formula  $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{NH}_4\text{NO}_3$  and  $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{NH}_4\text{NO}_3$ . Both the double salts are incongruently saturating at 30° and are hence unstable in contact with water. The crystals of the double salt  $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{NH}_4\text{NO}_3$  are quite well-defined and large in size, whereas  $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{NH}_4\text{NO}_3$  is formed almost as a fine powder. Conditioned by its relatively less

solubility, ammonium sulphate occupies the largest area in the saturation field. Methods have been developed to prepare the double salts in fairly pure state at room temperature. The double salts are intermediate in their hygroscopicity ammonium nitrate and ammonium sulphate.

**146. Preparation of Titanates and their solid solutions.**

S. K. K. JATKAR and N. V. Kaulgud, Poona.

The preparation of Lead Titanate and of a solid solution  $(\text{Pb}_{0.8}\text{Ba}_{0.2})\text{TiO}_3$  has been studied by microscopic and X-ray diffraction methods. Barium Titanate is formed at a high temperature (ca.  $1200^\circ\text{C}$ ) but a solid solution of the same with large percentage (80%) of Lead Titanate could be prepared comparatively easily at a much lower temperature ( $950^\circ\text{C}$ ) and was experimentally realized as evidenced by powder diffraction patterns.

**147. Purification of Technical Monoglycerides by liquid-liquid extraction technique.**

R. BASU ROY CHOUDHURY, Calcutta.

Various workers have tried to purify technical monoglycerides. The present investigator has purified technical monoglycerides to the extent of 98% purity by using the liquid-liquid extraction technique. The solvent pair used for this purpose was 80% ethanol and petroleum ether. The procedure as carried out was  $4 \times 4$  completion of squares. Equal volumes of solvent were used in each extraction and a dilution of 1 to 40 of glyceride to solvent was used.

**148. Effects of End Groups on the Osmotic Slope of Polymethylacrylate.**

SATYA RANJAN CHATTERJEE, Calcutta.

Methyl acrylate was polymerized in different solvent media at  $80^\circ\text{C}$  by employing solution polymerization method. The polymer samples were obtained by precipitation after polymerization had proceeded for various lengths of time. The osmotic pressure measurements were made in N-N'-dimethyl formamide solution at  $35^\circ\text{C}$ . It was found that the osmotic slope obtained by plotting  $\pi/C$  against  $C$  differs appreciably from sample to sample. The slope shows the highest value in case of polymer prepared in bromoform and negative values were obtained for the state in case of samples prepared in sec-butyl alcohol and iso-butyl alcohol. Since osmotic slope is a measure of the solvent polymer interaction it was suggested that the change in the slope might be due to the presence of the end groups of different solvent molecules which have entered the polymer chain by solvent transfer.

**149. Solvent Effect in Addition Polymerization.**

JYOTIRINDRA N. SEN, Calcutta.

The effect of benzene, toluene, acetic acid, isobutyric acid, ethyl acetate and tert-butyl alcohol in the thermal polymerization of styrene and methyl methacrylate has been studied at  $80^\circ\text{C}$ . The rate and the degree of polymerization cannot be correlated satisfactorily with the viscosity of the polymerizing system and solubilities of the polymers in the solvents. With styrene the rate of polymerization

is the same in all the six solvents, but the polymer is highly soluble in toluene, sparingly soluble in acetic acid and insoluble in tert-butyl alcohol. With methyl methacrylate the highest yield in acetic acid also corresponds to a high viscosity of the solution; but benzene though it gives a viscous solution, does not show a corresponding increase in rate of polymerization. It is concluded that the mechanism of thermal initiation of polymerization, viscosity of the medium, and the potentiality of the system to form a colloidal dispersion of swollen polymer particles should be taken into account to explain the phenomenon.

#### 150. Rate Constant in Polymerization of Styrene.

U. S. NANDI, Calcutta.

Styrene has been polymerized in bulk by employing 2,2' azobisisobutyronitrile as initiator within a temperature range of 30° to 117°C. Rate constants for transfer to monomer ( $C_m$ ) and  $\delta$ , the ratio between the square root of the termination constant to the propagation constant have been evaluated. The values of  $C_m$  at 30°, 50°, 60°, 80° and 117°C are  $2 \times 10^{-5}$ ,  $4 \times 10^{-5}$ ,  $6 \times 10^{-5}$ ,  $10 \times 10^{-5}$  and  $14 \times 10^{-5}$  respectively having an energy of activation of 5.3 kcal.  $\delta$  values at 30°, 50°, 60°, 80° and 117°C are 48.93, 35.15, 28.62, 19.36 and 9.45 and the corresponding value of  $E_p - \frac{1}{2}E_t$  being equal to 4.47 kcal.

#### 151. Kinetic Study of Methyl Acrylate Polymerization.

U. S. NANDI, Calcutta.

The kinetic of the polymerization of methyl acrylate initiated by hydrogen peroxide in solutions of ethyl acetate, methyl ethyl ketone and n-butyl alcohol has been studied at 50°, 60° and 80°C. The peroxide admits of no inhibition period, the % P curve being linear with respect to time after a certain induction period. The rate of polymerization was found to be proportional to the square root of the catalyst concentration, over a ten fold increase in the concentration of the initiator. The orders of reaction with respect to monomer concentration are 1.5, 1.3 and 1.2 in n-butyl alcohol, methyl ethyl ketone and ethyl acetate respectively. The rate constant  $\delta$  ( $=k_t/2k_p$ ) at temperatures 50°, 60° and 80°C are 2.49, 1.64 and 0.82 respectively, the energy of activation being 8.42 kcal.

Results with hydrogen peroxide as initiator have been compared with our results with benzoyl peroxide as initiator in methyl acrylate polymerization. The similarity in the kinetic behaviour of the two peroxides are excellent and proves the ideal behaviour of hydrogen peroxide in solution polymerization. The variation in the order of the reaction with respect to monomer concentration has been explained in the light of efficiency of the catalyst in different solvents.

#### 152. Rate Constants in the Polymerization of Methyl Methacrylate.

U. S. NANDI, Calcutta.

The determination of the rate constants of  $C_m$  and  $\delta$  in methyl methacrylate polymerization has been carried out with a number of catalysts over a temperature range of 35° to 115°C. The catalysts employed are hydrogen peroxide, benzoyl peroxide, 2,2' azobisisobutyronitrile, 1,1' azobiscyclohexane carbonitrile, 2,2' azobis-2-methyl butyronitrile, 2,2' azo, 2,4 dimethyl butyronitrile, 2,2' azo-2-methyl 3,3' dimethyl butyronitrile and 2,2' azo 2-ethyl butyronitrile. Our experimental results have been compared and found to be in good agreement with others existing in the

literature. The data on these rate constants available so far have been compiled with our results and their energies of activation and frequency factors have been calculated over a temperature range of 20° to 115°C. They may be represented as

$$\delta = 9.4 \times 10^{-3} \exp. (4,400/RT)$$

$$\text{and } C_m = 9.1 \times 10^4 \exp. (-7,600/RT)$$

### 153. Hydroperoxide as Initiator in Methyl Methacrylate Polymerization.

A. K. CHOWDHURY, Calcutta.

1-hydroperoxy cyclohexyl 1-hydroxy cyclohexyl peroxide was synthesized in this laboratory after the method of Milas and was employed as initiator in the bulk polymerization of methyl methacrylate at temperatures 50° and 60°C. The polymerization with the hydroperoxide involves no inhibition period and the proportionality of the rate of polymerization with the square root of the initiator concentration is maintained.

Various rate constants e.g.,  $C_m$ ,  $C_i$  and  $\delta$  have been evaluated and compared with results obtained from the polymerization of this monomer with benzoyl peroxide and 1,1' azobis cyclohexane carbonitrile. The agreement between the results obtained with these three initiators are fairly good and they are

	50°C	60°C
$C_m$	$0.8 \times 10^{-5}$	$1.0 \times 10^{-5}$
$C_i$	$1.86 \times 10^{-3}$	$2.79 \times 10^{-3}$
$\delta$	10.73	9.79

### 154. Chain Transfer Constants in the Polymerization of Methyl Acrylate.

U. S. NANDI, Calcutta.

Chain transfer coefficients for monomer ( $C_m$ ), for initiator ( $C_i$ ) and for solvent ( $C_s$ ) in the hydrogen peroxide initiated polymerization of methyl acrylate have been determined at temperatures of 50°, 60° and 80°C. The values of  $1.3 \times 10^{-4}$ ,  $8.4 \times 10^{-4}$  and  $5.7 \times 10^{-4}$  for  $C_m$  and  $3.3 \times 10^{-3}$ ,  $2.3 \times 10^{-3}$  and  $1.3 \times 10^{-3}$  for  $C_i$  have been obtained at 80°, 60° and 50°C respectively, the energies of activation being 6.03 kcal for  $C_m$  and 5.28 kcal for  $C_i$ .

The determination of solvent transfer in the catalysed system by the method of Mayo has again proved to be inefficient in case of this monomer also and our modified methods (Palit, Nandi and Saha, J. Poly. Sci., 14, 295, 1954) have been successfully employed in all the cases studied. Chain transfer for methyl ethyl ketone, ethyl acetate and n-butyl alcohol in methyl acrylate have been determined at 60°C both from catalysed and uncatalysed systems.

### 155. The Role of Solvents in Initiating Chains in the Uncatalyzed Polymerization.

U. S. NANDI, Calcutta.

With the conception that monomer collision leads to the initiation reaction in the uncatalyzed vinyl polymerization the order of the reaction with respect to monomer concentration comes out to be two. In the uncatalyzed polymerization of methyl methacrylate in solutions of ethyl acetate, cyclohexane and methyl ethyl ketone the order was found to be 1.45, 1.55 and 1.01 respectively at 60°C at concentrations ranging from 0.93 moles/lit to 9.3 moles/lit. In case of styrene in ethyl acetate the value was found to be 1.8.

This variation has been supposed to be due to the solvent taking part in the initiation process which may be shown as



and the rate equation to be

$$R_p = k_p M (k_1 M^2 + k_{1s} MS)^{1/2} / k_t^{1/2}$$

In cases where  $k_1 M^2 \gg k_{1s} MS$  the order of  $R_p$  with respect to monomer is 2 but in the reverse case of  $k_{1s} MS \gg k_1 M^2$  the order of reaction comes out to be 1.5 as a result of which orders between 1.5 and 2.0 are obtained in solutions of different solvents. The value of 1.01 in case of methyl ethyl ketone has been explained to be due to catalytic effect.

#### 156. Critical Test of the Kinetics of Solvent Transfer Reaction in Uncatalysed Polymerization.

U. S. NANDI and A. K. CHOWDHURY, Calcutta.

An extensive study on the kinetics of the chain transfer reaction for solvents in the uncatalysed polymerization of methyl methacrylate has been carried out. In case of methyl methacrylate the plot of the reciprocal degree of polymerization ( $1/P$ ) against solvent monomer ratio ( $S/M$ ) does not meet at the same point in different solvents not to speak of at the ( $1/P$ ) for bulk polymerization. Studies with ethyl acetate, methyl ethyl ketone and cyclohexane at 60°C in methyl methacrylate at concentrations near bulk shows a steep fall or steep rise depending on the nature of solvent and finally meets at the ( $1/P$ ) for bulk polymerization. This peculiar behaviour of this monomer of not obeying the general equation of Mayo at all concentrations has been explained on the variation of the order of the rate of polymerization on the monomer concentration. In solvents where the order of reaction with respect to monomer concentration is two, as seen in our experimental work with styrene in ethyl acetate the plot of  $1/P$  against  $S/M$  is linear at all concentrations and obeys Mayo's equation nicely. The discrepancy in the case of methyl methacrylate has been correlated with the solvent effect in the initiation reaction. Rates of polymerization have been determined dilatometrically.

#### 157. Radical Displacement Reactions in the Thermal Polymerization of Methyl Acrylate in Solution.

JYOTIRINDRA N. SEN, Calcutta.

The chain transfer constants,  $C_s$ , in eighteen solvents including aliphatic, alicyclic and aromatic hydrocarbons, alcohols, ketones and chlorinated hydrocarbons have been determined for the polymerization of methyl acrylate at 80°C. The values of  $C_s$  for this monomer are in general higher than the corresponding values of  $C_s$  for styrene and methyl methacrylate. The affinity for the abstraction of hydrogen atom from the solvent compared with its tendency to add to the monomeric double bond is stronger in the case of methyl acrylate than that in the case of the monomers, styrene and methyl methacrylate. The situation is reverse when the displacement reaction involves a chlorine atom, so much so that the transfer constant for chloroform is higher than that for carbon tetrachloride in methyl acrylate polymerization. The results have been explained on the basis of the known electrophilic nature of the monomer and the polymer radical, and the resonance stabilization of the transition state in the displacement mechanism.

**158. Chain Transfer in Mixed Solvent System.**

U. S. NANDI, Calcutta.

From the general equation for the average degree of polymerization in a single monomeric system

$$1/\bar{P} = C_m + \delta^2/M^2 R_p + \sum C_s S/M$$

two methods have been postulated to determine the chain transfer ( $C_s$ ) of a solvent in mix-solvent system. (1) Keeping the  $S_1/M$  and  $S_2/M$  constant i.e.,  $S_1/M = S_2/M = S/M$  the equation is transformed into  $1/P = K + (C_{s1} + C_{s2}) S/M$  and  $C_{s1}$  and  $C_{s2}$  can now be determined from a plot of  $1/P$  against  $S/M$ . (2) Single tube experiments can be employed for the purpose when

$$C_{s2} = M/S_2 [1/\bar{P}] - C_m - C_{s1} (S_1/M) - \delta^2/M^2 R_p]$$

and knowing  $C_{s1}$  the value of  $C_{s2}$  can be evaluated. Experimental work in verification of the suggested methods have been carried out in the polymerization of methyl methacrylate in a number of mix-solvent systems e.g. toluene-ethyl acetate, methyl ethyl ketone-chloroform, methyl ethyl ketone-ethyl benzene, n-butyl alcohol-carbon tetrachloride and a variety of other such systems at 60°C. The results are in excellent accord with the suggested methods and has been further developed for application in case of those substances which are immiscible with a particular monomeric system.

**159. Radical Displacement Reaction in the Thermal Polymerization of Styrene in Solution.**

JYOTIRINDRA N. SEN, Calcutta.

Chain transfer constants,  $C_s$ , for the thermal polymerization of styrene at 80°C have been determined in eleven solvents, including hydrocarbons, alcohols, ketones, and carboxylic acids. The values of  $C_s$  are as expected on the basis of the activity of hydrogen atom in the various solvent molecules, and are of magnitude comparable with those determined by different workers in other solvents. The order of  $C_s$  is about  $10^{-4}$ — $10^{-5}$ .

**160. Effect of Solvent Transfer on the Molecular Weight Distribution.**

SATYA RANJAN CHATTERJEE, Calcutta.

Molecular weight distribution curves were drawn for polystyrene prepared by solution polymerization of the monomer in carbon tetrachloride at 60°C. For this purpose fractionation of polymer samples was carried out in methyl ethyl ketone using methyl alcohol as precipitant.

The experimental curves were compared with the theoretical curves obtained by using the equation of Palit and Majumdar (Proc. Ind. Assoc. Cult. Sci., 37, No. 7, 19, 1954) who have taken into account all sorts of transfer phenomenon and termination by disproportionation or combination. The agreement is quite satisfactory.

**161. Heats of Mixing of Cyclohexane and Chlorobenzene.**

S. N. BHATTACHARJEE, Calcutta.

The heats of mixing of system cyclohexane and chlorobenzene has been determined with the help of a modern microcalorimeter allowing no vapour phase at three different temperatures, 35.5°, 45° and 55°C. The system shows small posi-

tive heats of mixing which is to be expected from the nature of the components. It is only in approximate agreement with theory of strictly regular solutions proposed by Guggenheim with 'Zero-th approximation' which results in symmetrical  $\Delta H_m$  versus  $x$  curve. The results obtained are somewhat asymmetrical, maximum value occurring near  $x_1 = 0.545$  and can best be represented by

$$\Delta H_m = x_1 x_2 [A + B (x_1 - x_2) + C (x_1 - x_2)^2]$$

where  $x_1$  and  $x_2$  are mole fractions of cyclohexane and chlorobenzene respectively.

The interchange energy  $w$  varies with temperature and the values of  $w$ ,  $\delta w / \delta T$  and  $\delta^2 w / \delta T^2$  have been calculated. As expected  $w$  was found to decrease with temperature.

#### 162. Design and Construction of a Micro-calorimeter for Measurement of small Heats of Mixing.

S. N. BHATTACHARJEE, Calcutta.

A microcalorimeter for measurement of heat changes as low as 0.1 J has been constructed by utilising Tompa's idea of eliminating the vapour phase by keeping the liquid phase confined under mercury. The instrument has been designed mainly in the model of McGlashan and Adcock with certain important modifications.

Thus instead of a thin copper vessel as used by McGlashan and Adcock a thermally lagged multijacket has been introduced—as suggested by Tiam for short duration calorimetric work—to achieve a lesser fluctuation of background temperature. The calorimeter can be immersed under water inside the water tight jacket which in turn is kept submerged in a large thermostat of  $\pm 0.005^\circ\text{C}$  accuracy. The whole system is allowed to come to equilibrium without any stirring inside the jacket. Time to reach equilibrium is of course high (about 24 hours) which is its only disadvantage.

To eliminate further the uncertainty in heats of stirring, the mixing system in the mixer vessel has been mechanically coupled with its replica in the reference vessel so that the movement of one is exactly repeated in the other.

The calorimeter is tested by measuring heats of mixing of carbon tetrachloride and cyclohexane at different ratios at  $35.5^\circ\text{C}$ . The  $\Delta H_m/\text{mole}$  versus  $x$  and  $\Delta H_m/\text{mole}$  versus  $x, 1-x$  curve is found satisfactorily in agreement with results obtained by other workers.

The accuracy of the calorimeter was found to be better than  $\pm 2\%$ , major contribution to which is inaccuracy in time measurement. Work is in progress to confine this within  $\pm 1\%$  by utilising a better and modern method of time measurement.

#### 163. Determination of $K$ and $\alpha$ for Polymethyl Isopropenyl Ketone.

SATYA RANJAN CHATTERJEE and A. K. CHOWDHURY, Calcutta.

Molecular weight of high polymeric substances can be easily determined by using the Staudinger-Mark equation

$$[\eta] = K M^\alpha$$

where  $\alpha$  is a constant and is dependent on the flexibility of the chain,  $K$  is a constant and  $[\eta]$  is the intrinsic viscosity of the polymer solution. The above equation was applied in calculating the values of the two constants in case of polymethyl isopropenyl ketone. The monomer was synthesised in this laboratory by utilising the method suggested by Morgen, Megson and Pepper (Chemistry and

Industry, 885, 1938). The white polymer obtained by polymerizing the monomer in bulk at 35°C was fractionated into samples of different molecular weights by using the usual fractionation technique. Osmometric and viscometric measurements were carried out in solution of N-N' dimethyl formamide at 35°C K and were obtained from the intercept by plotting  $\log [\eta]$  vs.  $\log M$  their values being  $2.63 \times 10^{-4}$  and 0.83 respectively. The data obtained are found to be in agreement with the equation of Palit. (Ind. J. Phys., 29, 65, (1955).

#### 164. Decomposition of Chloro-substituted Benzoyl Peroxides in solution.

U. S. NANDI, Calcutta.

The rate of decomposition for ortho, para and meta substituted dichlorobenzoyl peroxide has been studied at a temperature of 80°C in solutions of ethyl acetate.

The decomposition of the dichlorobenzoyl peroxides are found to be inhibited by the presence of oxygen, quinone and hydroquinone and the rate of decomposition being suppressed in solutions of monomers. These results undoubtedly establishes the free radical decomposition of the peroxides. The order of the rate of decomposition of the dichlorobenzoyl peroxides is ortho>para>meta. In case of all the three peroxides the primary homolytic cleavage is followed by chain reactions of 3/2 order as suggested by Nozaki and Bartlett.

In styrene and methyl methacrylate the rates of decomposition of the dichlorobenzoyl peroxides diminish thereby showing that the induced decomposition is suppressed to some extent by the monomeric free radicals. The rates of initiation and the chain transfer coefficients for the three peroxides are also in the same order as their rates of decomposition predict. The initiation constants at 60°C for ortho, para and meta dichlorobenzoyl peroxides are  $2.64 \times 10^{-6}$ ,  $5.4 \times 10^{-6}$  and  $3.6 \times 10^{-6}$  respectively in methyl methacrylate. The values of  $C_i$  in the same order are 0.019, 0.009 and 0.003.

#### 165. Role of moisture in the isomerisation of thiocyanates of substituted ammonium derivatives.

R. D. GUPTA, THOMAS JOSEPH K. and VIJAYRAGHAVAN, Pilani (Rajasthan).

In an attempt to study the effect of addition of non-polar and polar liquids on the reversible system,



we selected use of small quantities of water.

About 10 gms. of finely powdered well mixed and desiccated (over phosphorus pentoxide) or moist (containing 5% water), samples of thiocyanates are heated at a particular temperature for known periods of time. At the end of period, the residue is analysed for unchanged thiocyanate and substituted thiocarbamide formed.

A comparison of the results of such determinations indicates that (1) less of corresponding thiocarbamide is formed from the moist sample and (2) less of heat is evolved from the moist sample.

The lowering of the yield of thiocarbamides may be due to the deactivations of thiocyanic acid and substituted ammonium molecules. It also lends support to the view that thiocyanic acid molecules, necessary for the conversion to isothiocyanic acid are produced as a result of thermal dissociation of thiocyanates of substituted bases; and not formed as an alternative by the ionization of thiocyanates of substituted bases.



**166. A reaction between Iodine and Sodium thiosulphate in Heterogeneous Liquid—Liquid System (Part III).**

P. S. JAVADEKAR, Sangli (Bombay).

A reaction between Iodine solution in Chlorobenzene and aqueous Sodium thiosulphate is studied in the present investigation. Potassium iodide was added to the aqueous phase with a view to increase the homogeneous part of the reaction. But the values of constants are not at all altered by even 10 gms. iodide and they are very slightly altered even by 25 gms. of iodide. This indicates that the reaction is strictly heterogeneous. The temperature coefficients are 1.14 and 1.16 showing the predominance of diffusion process. The effect of change in speed of stirring is appreciable. The change in concentration of iodine changes the velocity constants appreciably. But the change is not proportional to the concentration of iodine. A reaction between nonaqueous iodine solution and aqueous alkali is also under investigation.

**167. Studies in the kinetics of the reaction between Formic Acid and Potassium Persulphate—Part I.**

SATYA PRAKASH SRIVASTAVA and SATYESHWAR GHOSH, Allahabad.

In this paper we have shown that the reaction between formic acid and potassium persulphate is of a measurable speed above 30°C and was found to have an induction period after which the reaction becomes unimolecular with respect to persulphate. It is however, independent of the concentration of formate ion. The reaction was found to be appreciably catalysed by  $\text{Ag}^+$  and  $\text{Cu}^{++}$  ions the induction period of the reaction tends to disappear. Further, in presence of  $\text{Cu}^{++}$  ions, the unimolecular constant decreases with time, indicating the presence of secondary reactions or chain reactions. A general mechanism has been suggested for all reactions where persulphate ion acts as oxidising agent.

**168. Studies in the kinetics of the reaction between Formic Acid and Potassium Persulphate—Part II.**

SATYA PRAKASH SRIVASTAVA and SATYESHWAR GHOSH, Allahabad.

It has been shown in Part I that reaction between formic acid and potassium persulphate has an induction period and it is unimolecular with respect to persulphate and zero molecular with respect to formic acid.  $\text{Ag}^+$  and  $\text{Cu}^{++}$  have a catalytic effect and induction period also vanishes.

This paper deals with the salt effect in the presence of different concentrations of added potassium persulphate. The specific inhibitory effect of the halide ions has been investigated and the effect of the non-electrolyte urea has also been studied. A general mechanism for all reactions in which persulphate ion is the oxidising agent advanced in Part I is supported.

**169. Kinetics of oxidation of Glucose and Fructose by alkaline bivalent copper in presence of citrate—Part III.**

MATHURA PD. SINGH and SATYESHWAR GHOSH, Allahabad.

In earlier papers the reduction of cupric tartrate complex has been studied. This paper deals with the study of the reduction of cupric citrate complex by glucose and fructose in the presence of an alkali.

It has been observed that the amount of citrate required to keep the copper in solution is more than the equivalent amount. The cupric citrate complex thus produced is reduced by these sugars catalysed by alkali and also cuprous oxide a product of the reaction. This autocatalysis is more pronounced in the reaction where sugar is taken in large excess, as the primary particles of cuprous oxide are kept in finer state of suspension by the peptising action of sugars. Study of reaction velocity shows that the rate is not effected by citrate or tartrate used to form cupric complex.

The temperature coefficient and energies of activation are slightly different for the two reducing sugars studied here. These are lower for fructose than those for glucose.

**170. Kinetics of oxidation of Dextrose, Galactose and Fructose, l-arabinose and d-xylose by alkaline bivalent copper in presence of tartarate—Part IV.**

MATHURA PRASAD SINGH and SATYESHWAR GHOSH, Allahabad.

In this paper the effect of temperature on the reaction velocity has been studied for three hexoses, glucose, galactose and fructose and the two pentoses l-arabinose and d-xylose. The temperature coefficient and activation energy have been found. It has been observed that two optical isomers of hexoses glucose and galactose have slightly different activation energy between 30°C and 40°C. Reduction effected by fructose has also a low temperature coefficient than hexoses.

The pentoses l-arabinose and d-xylose behave like aldehydo hexoses but have different activation energies. Thus the following gradation has been observed for the activation energies in the case of hexoses :—

galactose > dextrose > fructose

Similarly in the case of aldehydo pentoses they are in the order l-arabinose > d-xylose.

As reported earlier the reaction is unimolecular with respect to reducing sugars but zero molecular with respect to cupric tartrate complex. Alkali, as usual, possesses a catalytic influence.

**171. The kinetics of the Ferric Thiosulphate reaction—Part I.**

D. PATNAIK, C. NANDA and K. BAKSHI, Cuttack.

A mechanism involving the two intermediates  $\text{FeS}_2\text{O}_6$  and  $\text{Fe}(\text{S}_2\text{O}_6)_2^-$  was suggested for the ferric thiosulphate reaction (Patnaik and Mahapatra, Curr. Sci., 1955, 24, 195). From this mechanism kinetic equations have been derived for the initial and maximum rates of decay which have been measured spectrophotometrically at different ionic strengths for varying concentrations of ferric and thiosulphate ions. The initial rate varies as the first power of the concentration of the ferric ion and the square of the concentration of the thiosulphate ion. On the other hand, the maximum rate varies as the square of the concentration of the coloured complex  $\text{FeS}_2\text{O}_6$ . These observations conform to the kinetic equations derived for the rates from the proposed mechanism, the various steps of which consist of bimolecular reactions between oppositely charged ions and ion-pairs. The decrease in rates, both initial and maximum, with the increase in ionic strength substantiates the fact that the rate controlling stages are reactions involving oppositely charged ions. Further these elementary reactions are in keeping with the general principle of economy of structural changes which lends support for the mechanism in addition to the agreement of the experimental data with the kinetic equations.

**172. Catalytic decomposition of Potassium Chlorate in the presence of a mixture of Catalysts and determination of the Temperature coefficients of the decomposition.**

L. M. APTÉ and P. S. JAVDEKAR, Sangli (Bombay).

Mixtures of Sulphate of Manganese with those of (1) Chromium, (2) Cobalt and (3) Vanadium chloride, as catalysts, are used to decompose potassium chlorate. It is found that the mixture of catalysts with Manganese as one component acts less effectively than the individual components of a mixture when each acts alone.

The temperature coefficients of the decomposition are also determined, between temperature 255°C, 265°C, 275°C and 285°C.

**173. Reaction between Amines and Carbon Dioxide at high pressure.**

K. Z. PATIL and M. R. A. RAO, Bangalore.

The reaction between amines and carbon dioxide is being investigated to find the mechanism of the reaction between amino group and carbon dioxide at high pressures. Dialkyl ureas are being synthesised by the interaction of aliphatic amines and carbon dioxide. Anhydrous hexylamine and carbon dioxide gave dihexyl urea at 2800 psi. pressure and 180°C temperature.

**174. Ammonolysis of Ethylene Dichloride.**

V. A. KRISHNAMURTHY and M. R. A. RAO, Bangalore.

The reaction of ethylene dichloride with ammonia under pressure has been investigated. The effect of experimental variables like temperature, time of reaction and the concentration of reactants have been worked out. An optimum yield of 68 per cent ethylene diamine was obtained at 110°C and a pressure of 200 p.s.i.g. when the time of reaction was 5 hours and the ratio of ammonia to ethylene dichloride was 17.

**175. Dielectric constant and Dipole moment: Part I—Coumarins.**

S. K. K. JATKAR and C. M. DESHPANDE, Poona.

The dielectric constant and density of coumarin are measured in the molten state at various temperatures. The dielectric constants and densities of coumarin, 4-methyl-6-ethyl-8-acetyl umbelliferone and 4-methyl-8-acetyl umbelliferone have been measured in solution at various concentrations and temperatures. The moments are calculated by applying the new equation and the values obtained are compared with the values calculated theoretically. The new moments are:

Coumarin :	4.89 (molten state)
	4.72 (solution)
4 me-6 Et-8 acetyl umbelliferone :	3.33—3.58
4 me-8 acetyl umbelliferone :	4.08

The moments of 4-me-6 Et-8 acetyl umbelliferone and 4-me-8 acetyl umbelliferone have been measured for the first time.

**176. Absorption and Fluorescence Spectra of Benzylidene: Coumaranones.**

S. K. K. JATKAR and B. N. MATTOO, Poona.

Absorption and fluorescence spectra of 4'-methoxy and 4'-benzyloxy benzylidene coumaranones have been reported and discussed. Effect of various substitutions has been studied.

Though strong fluorescence is met with in the solid state, yet the efficiency is low in solution. There is an appreciable 'inner filter' effect.

**177. Compressibility and Electric Polarisation.**

S. K. K. JATKAR and D. D. DESHPANDE, Poona.

In the present paper, the compressibility ( $\beta$ ) of pure organic liquids has been shown to be correlated with the specific orientation polarisation ( $P_s$ ). The graph of  $\beta$  against  $P_s$  for homologous series of polar liquids gives st. lines originating from a single point on the  $\beta$  axis where  $P_s = 0$ , but possessing different slopes for different homologous series. The relation is represented by an equation  $\beta = C + D \times P_s$ , where 'C' the common intercept has a value of  $45 \times 10^{-12}$  cm<sup>2</sup>/dyne. The relation holds good for adiabatic as well as isothermal compressibilities. It can be qualitatively said that the slopes of the lines i.e.  $\Delta\beta/\Delta P_s$  depend on the hinderance in rotation of the dipole molecule.

**178. Photographic and Photoelectric Spectropolarimetry.**

S. K. K. JATKAR and A. J. MUKHEDKAR, Poona.

Rotatory dispersion has theoretical and analytical applications. A Photographic spectropolarimeter for ultraviolet and a photo-electric instrument for the visible region have been set up. For photographic technique a densitometer is used to determine the line having equal intensity of the two halves. In the photo-electric technique the angle of rotation  $\alpha$  is determined by using the equation

$$I = A \sin^2 \alpha \text{ for the intensity-rotation curve.}$$

**ORGANIC CHEMISTRY****179. Isoquinoline Derivatives—Part III.**

T. N. GHOSH, BHABATOSH BHATTACHARYA and SAKTIPADA DUTTA, Calcutta.

In contrast with the earlier observation (Ghosh and Dutta, *J. Indian Chem. Soc.*, 1955, 32, 17, 755) that treatment of ( $\alpha$ -acetamido- $\beta$ -phenyl)-ethylmethyl ketone and of  $\beta$ -phenyl-substituted analogues with POCl<sub>3</sub> or conc. H<sub>2</sub>SO<sub>4</sub> leads to the formation of 1-methylisoquinoline derivatives, accompanied with dehydrogenation and deacetylation, ( $\alpha$ -acetamido- $\beta$ -phenyl)-ethylphenyl ketone and  $\beta$ -phenyl-substituted analogues yield, under similar condition, oxazole derivatives. The failure in inducing  $\alpha$ -methyl- $\alpha$ -amino- $\beta$ -phenylpropionic acid to respond to Dakin and West reaction has been discussed in the light of the two mechanisms as proposed by earlier workers for this reaction. Methyl  $\alpha$ -acetamido- $\alpha$ -methyl- $\beta$ -phenylpropionate undergoes Bischler-Napieralski cyclisation to yield the corresponding isoquinoline derivative. Condensation of  $\alpha$ -acetamido- $\alpha$ -methyl- $\beta$ -phenylpropionyl chloride with ethyl sodiomalonate leads to the formation of an oxazole derivative.

**180. Synthesis of 8-aminoquinolines: Part VII.**

A. RAYCHAUDHURI and U. P. BASU, Calcutta.

The enhancement of antimalarial activity by a 7-chlorine substituent in 4-amino quinoline series has stimulated attempt to synthesise analogues of Pamaquin with a 7-chlorine atom instead of the 6-methoxy group. Price and Guthrie failed in their attempt to condense 7-chloro-8-amino quinoline with dialkyl amino alkyl halides (*J. Amer. Chem. Soc.*, 1946, 68, 1942). In this laboratory an attempt was made to prepare this type of compounds by the interaction of the sodium derivative of 7-chloro-8-*p*-toluene-sulphonamido quinoline with appropriate amino-alkyl halides and detosylation of the products. Although the intermediate dialkyl aminoalkyl-*p*-toluene sulphonamido quinolines were obtained in good yield the detosylation of the compounds by the various known methods including that of Weisblat, Magerlein and Myers (*J. Amer. Chem. Soc.*, 1953, 75, 3630) could not be achieved.

7-chloro-8-(1'-methyl-4' diethylamino-butyl) amino-quinoline was, however, prepared by a different route. 2:3 Dichloro nitrobenzene was reacted with 1-diethylamino 4-amino pentane to afford 2-chloro-6 nitro 1'-methyl-4' diethylamino butyl aniline. This was reduced with stannous chloride and the corresponding amine was subjected to Skraup reaction to yield the desired product. The compound was isolated as the methylene-bis-salicylate.

**181. Iso-quinolines as potential antispasmodics.**

A. RAYCHAUDHURI and ARUN BOSE, Calcutta.

The observation on the spasmolytic activity of 3-methyl isoquinolines (Kreitmaier, *Arch. exp. Path. Pharm.*, 1932, 164, 509; Polgar and Zelenka, *Magyar Nogyoyszok Lapja*, 1948, 7, 1) has led to the attempts of incorporating substituted amino-methyl grouping in the 3-position of the isoquinoline nucleus. In connection with the synthesis of 1-phenyl-3-substituted amino-methyl isoquinoline (I), the oxime of 1-phenoxy-3-phenyl propan-2-one (II) was reduced with sodium and alcohol to furnish 1-phenoxy-2-amino-3-phenyl propane (III). This amine was benzoylated and submitted to Bischler-Napierliski cyclisation to afford 1-phenyl-3-phenoxy-methyl-3:4 dihydro iso-quinoline (IV). (IV) on catalytic dehydrogenation and reaction with hydrobromic acid would afford the 3-bromomethyl iso-quinoline derivative (V) which on further reaction with amines is expected to yield the desired compounds of type (I).

**182. Merocyanines—Part I.**

B. K. PATNAIK and M. K. ROUT, Cuttack.

In the present investigation, the preparation of five merocarbocyanines derived from thiazoles and containing substituents in the dimethine bridge have been described. The thiazole compounds used were as follows—4-Phenyl-2-methyl thiazole, 4-*p*-Methoxyphenyl-2-methyl-thiazole, 4-*p*-Ethoxyphenyl-2-methyl thiazole, 4-*p*-Nitrophenyl-2-methyl-thiazole and 4-*p*-Bromophenyl-2-methyl-thiazole. Rhodanine and 3-ethyl rhodanine were used for the acidic components.

**183. Photographic sensitizers—Part I: Merocarbocyanines.**

B. K. PATNAIK and M. K. ROUT, Cuttack.

In the present investigation, the preparation of five merocarbocyanine dyes derived from 4-phenyl-2-methyl-thiazole, 4-*p*-methoxyphenyl 2-methyl thiazole, 4-*p*-

ethoxyphenyl 2-methyl thiazole, 4-p-bromophenyl 2-methyl thiazole and 2-methyl benzothiazole have been described. Their acetanilido vinyl intermediates were first prepared and then condensed with 3-ethyl-rhodanine to give the desired merocyanines.

#### 184. Antispasmodics—Part I: Quinolyl Thiazoles.

BHASKAR DAS and M. K. ROUT, Cuttack.

In the present work, the preparation of some quinolyl thiazoles for use as antispasmodics has been undertaken. They were prepared from 2-arylimino 4-thiazolidones through condensation with o-nitro-benzaldehyde and subsequent reduction with zinc dust and acetic acid.

#### 185. Possible Antiamoebic Agents (Part II): Mannich bases from Chloro-Chroman-4-ones.

A. B. SEN and YASHWANT D. KULKARNI, Lucknow.

Twelve mannich bases have been prepared from 6-chloro-8-chloro-and 6, 8 dichloro chromanones with a view to test them for their antiamoebic activity. These chromanones were synthesized by the cyclisation of  $\beta$ -(o-chloro phenoxy),  $\beta$ -(p-chloro phenoxy) and  $\beta$ -(2, 4-dichloro phenoxy)-propionic acids by means of concentrated sulphuric acid (98%). The  $\beta$ -phenoxy-propionic acids were obtained by the condensation of  $\beta$ -propiolactone and the appropriate sodium-phenates.

The mannich reactions were carried out using equimolar quantities of the chromanone, paraformaldehyde and one of the secondary amines viz., dimethylamine, piperidine, morpholine and benzylamine as the hydrochlorides; in dry benzene as solvent and heating it under reflux for six hours.

#### 186. Oxygen Heterocycles.

A. B. SEN and M. S. SAXENA.

Oxygen Heterocycles such as isoflavones and isoflavens have been reported by Bradbury and White J. C. S. 1951, 3447, 1953, 871, to possess estrogenic activity. Following Bui Hoi et al, J. C. S. 1955, 3693 we have synthesized a no. of benzofurans (another group of Oxygen Heterocycles) with a view to test them for estrogenic activity.

#### 187. Synthesis of substituted Sulpha Thiazoles.

A. B. SEN and A. K. ROY, Lucknow.

A. S. C. has been condensed with different substituted 2-amino-thiazoles to obtain the corresponding sulphonamides in order to study the therapeutic activity.

#### 188. Search for New Insecticide—Part D.

A. B. SEN and A. K. SEN GUPTA, Lucknow.

Fifteen phenothiazines with different substituents like alkyl, alkoxy and halogen were prepared with a view to study the effect of these substituents on the insecticidal activity. These groups are known to effect a marked variation in the solubility of the compounds in lipid and water.

The diphenylamines required in the above experiment were obtained by condensing acetylated aromatic amines viz., 2-methoxy, 4-methoxy, 2-ethoxy, 2-chloro and 4-chloro aminobenzenes with bromobenzene, ethylbromobenzene and para bromo

toluene after the method of Goldberg (Ber., 1907, 40, 4543) and subsequent deacetylation with dilute hydrochloric acid and ethanol. The phenothiazines were obtained by fusing sulphur and the above substituted diphenylamines in the presence of 1.2 moles of anhydrous aluminiumchloride (Ackermann, 1911, 10, 144).

#### 189. Substituted Benzophenones.

R. S. TADAKOD, S. N. KULKARNI and K. S. NARGUND, Dharwar.

Substituted benzophenones have been prepared by Friedel-Crafts condensation of Para-Nitrobenzoylchloride with cresolmethylethers, mono- as well as dimethylethers of hydroquinone, resorcinol, catechol, chloroanisoles and n-alkylbenzenes. The resulting benzophenones have been characterised by the preparation of 2:4 dinitrophenylhydrozone derivatives.

Further work on the reduction of the above Nitrobenzophenones to the amino benzophenones is in progress.

#### 190. Chloro- & dichloro Xanthoncs.

C. N. DESPANDÉ, S. N. KULKARNI, and K. S. NARGUND, Dharwar.

o-chlorobenzoic acid and 2:5-dichlorobenzoic acid have been condensed by Ullmanns reaction with o-and p-chlorophenols, and 2:4-dichlorophenol to obtain the following ethers :

			M.P.
2'-carboxy-2-chlorodiphenylether	...	...	124°
2'-carboxy-4-chlorodiphenylether	...	...	119°
2'-carboxy-2:4-dichlorodiphenylether	...	...	141°
4'-chloro-2'-carboxy-2-chlorodiphenylether	...	...	136°
4'-chloro-2'-carboxy-4-chlorodiphenylether	...	...	132°
4'-chloro-2'-carboxy-2:4-dichloro-diphenylether	...	...	122°

The above acids were cyclised by concentrated sulphuric acid to obtain corresponding chloro and dichloroxanthoncs of which the following are new :

2:4-dichloroxanthone	...	...	M.P. 205°
4:7-dichloroxanthone	...	...	„ 173°
2:7-dichloroxanthone	...	...	„ 229°

#### 191. n-Alkyl and Chloro-substituted Xanthoncs.

S. S. MUTALIK-DESAI, S. N. KULKARNI and K. S. NARGUND, Dharwar.

n-Alkyl and Chloro substituted xanthoncs have been prepared with a view to test them for antibacterial activity. o-chlorobenzoic acid has been condensed with p-ethylphenol, and p-n-propylphenol. 2, 5 Dichlorobenzoic acid has also been condensed with p-cresol and o-cresol by following the method of Ullmann.

The above acids were cyclised by concentrated sulphuric acid to obtain the corresponding xanthoncs.

#### 192. Chloro and Dichlorothioxanthoncs.

NARAIN MAHISHI, B. S. CHIKKERUR, P. B. SATTUR and K. S. NARGUND, Dharwar.

Chloro and Dichloro thioxanthoncs have been prepared with a view to test them for antibacterial activity. Appropriate thiophenol has been condensed with o-chlorobenzoic acid in presence of sodium methoxide to obtain the intermediate acid which after treatment with sulphuric acid gave the corresponding thioxanthone.

### 193. Experiments on the synthesis of benzo- and tetrahydrobenzo—Coumarins. Part I.

S. SIDDAPPA and Y. V. SATHYABHAMA DEVI, Bangalore.

In connection with the investigation of the lactones, Corylifolean and isopsoralidin isolated from the seeds of *Psoralea corylifolia*, L., the synthesis of benzol- and tetrahydrobenzocoumarins was undertaken. The synthesis of the following coumarins by using the Pechmann reaction are described in the present paper:—

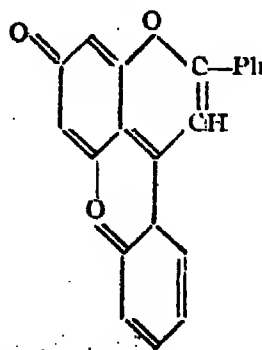
- (1) 3', 4', 5', 6'-tetrahydro-6:7-benzocoumarin, colourless needles, m.p. 128-130°C.
- (2) 4-methyl-3', 4', 5', 6'-tetrahydro-6:7-benzocoumarin, silvery plates, m.p., 85-87°C.
- (3) Ethyl-3', 4', 5', 6'-tetrahydro-6:7-benzocoumarin-4-acetate, colourless cubes, m.p. 130°C.
- (4) 3', 4', 5', 6'-tetrahydro-6:7-benzocoumarin-4-acetic acid, colourless needles, m.p. 156-158°C.
- (5) 8-Nitro-6:7-benzocoumarin, greenish yellow needles, m.p. 117-118°C.
- (6) Ethyl 8-Nitro-6:7-benzocoumarin-4-acetic ester, brown needles, m.p. 123-4°C.
- (7) 8-Nitro-6:7-benzocoumarin-4-acetic acid, yellow needles, m.p. 102-3°C.

### 194. Experiments on the synthesis of Dracorubin.

CH. BHETHMASANKARA RAO, P. LAKSHMANA RAO and  
V. VENKATESWARLU, Waltair.

As a preliminary to the synthesis of dracorubin, the synthesis of compounds similar to dracorubin but simpler than dracorubin itself has been attempted and one such successful synthesis is reported. O-Dimethyl-phloroglucinol was condensed with ortho-bromo-benzoic acid sodium salt in the presence of copper powder and the condensation product, ortho-(3:5-dimethoxy-phenyl)oxy-benzoic acid was converted into its methyl or ethyl ester which was subsequently condensed with acetophenone in presence of sodamide giving rise to the diketone, ortho (3:5-dimethoxy-phenyl) oxy-  $\alpha$ -benzoyl-acetophenone which was further characterised by the formation of its copper salt. The same diketone was also synthesised by a different method using ortho (3:5-dimethoxy-phenyl) oxy-acetophenone (synthesised using O-dimethyl-phloroglucinol and ortho-bromacetophenone) and ethyl benzoate in presence of sodamide. This diketone cyclised in two stages to give the required compound on gentle heating with hydriodic acid.

This successful synthesis suggests that a synthesis of dracorubin could possibly be achieved starting from the flavan unit, ethyl-7-hydroxy-5-methoxy-flavan-8-carboxylate and 5-bromo-4-methyl-resorcinol and build the anhydro-benzopyranol structure. This synthesis is still in progress.





**195. Studies on the Active Principles of *Zanthoxylum rhetsa* Triphal.**

ASIMA CHATTERJEE and CHANDRACHUR GHOSH, Calcutta.

Under the research programme on "The Survey of Alkaloids in *Rutaceous* Plants", the chemical constituents of South Indian and Assam varieties of *Zanthoxylum rhetsa* Triphal have been examined. The stem-bark of the South Indian species contains a triterpene alcohol,  $C_{30}H_{50}O$ , m.p.  $212^{\circ}$  (yield, 0.4%) which has been found to be identical with lupeol by direct comparison of the substances and their corresponding derivatives. Two other compounds called A (m.p.  $270-72^{\circ}$ , dec.) and B (m.p.  $254^{\circ}$ ) have also been found to occur in this plant material. Both of them are neutral, nonalkaloidal and nonphenolic compounds. They are not also coumarin derivatives.

From the stem-bark of *Zanthoxylum rhetsa* Triphal collected from Assam, several colourless alkaloids have been obtained in poor yield (0.008%) besides lupeol (yield, 0.7%) and the compound A. The colour reactions and the properties of the alkaloids have been studied.

**196. Isolation of Inuline—A New Alkaloid from *Inula royleana* D.C.**

ASIMA CHATTERJEE and SUNILKUMAR TALAPATRA, Calcutta.

*Inula-royleana* D.C. (Fam. *Compositae*) has been found to contain in its roots a new alkaloid, inuline, m.p.  $165^{\circ}$  (dec.), besides another base roylene  $C_{21}H_{33}$ ,  $37.6^{\circ}$  N m.p.  $128^{\circ}$  (dec.).

Inuline, the empirical formula of which agrees with  $C_{11}H_{23}O_4N$ , responds to the Labat test for methylene-dioxy group, and carries two methoxyl and at least one C-methyl functions. N-methyl data as estimated by Herzig-Meyer's method shows half the value required for one N-methyl grouping.

Purity and homogeneity of inuline have been established by column and paper chromatography experiments as also by X-ray analysis. The base yields a chloroplatinate  $C_{22}H_{44}O_4N_2 \cdot H_2PtCl_6$  which does not melt but decomposes above  $270^{\circ}$ . It also forms a chloroaurate which decomposes above  $200^{\circ}$ .

Other salts of inuline, e.g., hydrochloride, sulphate, nitrate, perchlorate, oxalate and picrolonate etc. could not be prepared in crystalline state as yet. Inuline is optically active and dextro-rotatory,  $[\alpha]^{20} = +44.3^{\circ}$  ( $CHCl_3$ ).

D

It is moderately soluble in hot ethanol and methanol, less so in these solvents at room temperature, highly soluble in chloroform, acetone and benzene and sparingly soluble in petroleum ether. It imparts to its aqueous solution (in which it is very slightly soluble) an extremely bitter taste.

It crystallises in stout needles from alcohol, the latter appearing in crystals as solvent of crystallisation.

**197. Dictamnine, an Alkaloidal Constituent of the Heart-wood of *Aegle marmelos* Correa.**

ASIMA CHATTERJEE and SUNIL ROY, Calcutta.

The heart-wood extractives of *Aegle marmelos* Correa (Fam. *Rutaceae*) have been found to contain several compounds from which (a) dictamnine,  $C_{11}H_{15}NO(OCH_3)$ , m.p.  $133^{\circ}$ , a furoquinoline alkaloid of linear structure, b)  $\beta$ -sitosterol,  $C_{27}H_{48}O$ , m.p.  $138-39^{\circ}$ , (c) a furocoumarin, marmesin,  $C_{14}H_{14}O_4$ , m.p.  $189^{\circ}$  (an optical antipode of nodakenetin) and (d) a neutral compound, m.p.  $133-34^{\circ}$  have been isolated in pure and homogeneous state by chromatographic method.

*Acgle marmelos* Correa thus appears to be of special interest as a good natural source of dictamnine which has been found to occur so far only in the roots of *Dictamnus albus* Linn (Fam. Rutaceae) and *Skimmia repens* Nakai (Fam. Rutaceae).

#### 198. Isolation of "Tetrabyrine" from Rauwolscline.

ASIMA CHATTERJEE and ANIMA BHATTACHARYA (Née Choudhury),  
Calcutta.

Rauwolscline the alkaloid of *Rauwolfia canescens* L. upon alkali fusion at 300°, undergoes cleavage and produces several products which are characterised as (A) indole-2-carboxylic acid, (B) harman and (C) isophthalic acid. Recently "Tetrabyrine",  $C_{11}H_{12}N_2$  (=2, [3' - {5:6:7:8 tetraisoquinolyl}] - 3-ethyl indole) has also been isolated in a fairly good yield from the alkali fusion products of rauwolscline. "Tetrabyrine" is found to be present in the basic fraction of the alkali fusion products along with harman and has been separated from the latter by fractional distillation under high vacuum. It distils at 295-300°/0.01 mm, crystallises from benzene in fine needles, m.p. 166°, and shows no depression in m.p. upon admixture with an authentic sample of "Tetrabyrine" prepared from rauwolscline by selenium dehydrogenation.

#### 199. Distribution of weakly basic Alkaloids in various parts of *Rauwolfia Serpentina* Benth.

BITHIKA BOSH, Calcutta.

Occurrence of medicinal constituents in *Rauwolfia serpentina* Benth were known to ancient Indians. Several alkaloids are being now isolated, and attempts are being made all over the world to work out structure and formula, and to ascertain physiological properties of each one. From preliminary experiments it has been found that bitter principles are distributed in all parts of the plant.

A new method has been worked out to estimate precisely how a group of weakly basic alkaloids exist in a growing plant.

#### 200. Glycosidic constituents of 'Chana' (*Cicer arietinum* Linn)—Part I. Isolation of three new crystalline glycosidic fractions from 'chana' meal.

J. L. BOSE, Poona.

Three new crystalline glycosidic fractions were isolated from the alcoholic extractive of defatted 'chana' meal by partitioning between dilute alcohol and ether-petroleum ether and subsequent fractionation through solvents.

Glycoside (I),  $(C_{18}H_{26}O_5)_n$  crystallised from dilute alcohol in clusters of colourless rectangular plates, m.p. 241-42° (decomp.)  $[\alpha]_D^{20} = -6.4^\circ$  and gave on acid hydrolysis aglycone (I),  $C_{18}H_{24}O_4$ , clusters of colourless plates from alcohol, m.p. 258-60°,  $[\alpha]_D^{20} = -53.2^\circ$ . The sugar residues were identified as glucose and rhamnose by paper chromatography. Glycoside (II),  $(C_{18}H_{26}O_5)_n$ , was obtained from methanol in small colourless prisms, m.p. 224-25° (decomp.) and gave on acid hydrolysis aglycone (II),  $C_{18}H_{24}O_4$ , small colourless needles, from dilute methanol, m.p. 212-14°. Glycosidic fraction (III), small colourless prisms from methanol, m.p. 265-70° (decomp.), could not be characterised owing to lack of sufficient material.

Both of the aglycones (I) and (II) appear to belong to the group of triterpene alcohols. Further work to elucidate their nature is in progress. Similar crystalline glycosidic fractions have also been isolated from 'chana' after incipient germination.

**201. The Seed Pulp of *Caesalpinia*.**

A. S. MITRA, Balasore.

A crystalline bitter substance has been isolated from the seed pulp of *Caesalpinia Bonduc*. Infra-red absorption spectrum of this bitter material indicates that it possesses lactonic, hydroxyl, ketonic and side methyl functions. Ultra-violet absorption spectrum indicates that it possesses ketonic function. Loss of one molecule of water from it on heating under vacuum indicates that it possesses a tertiary hydroxyl group. Lactone titration shows that it possesses two lactonic functions. It is laevorotatory.

**202. Mucilage from the seeds of *Ocimum basilicum*, Linn.**

M. A. SHAIKH and V. A. PATWARDHAN, Sangali.

The seeds of the plant, *Ocimum basilicum*, Linn. (Sabja), grown on the premises of the Willingdon College, yielded on extraction with 2 per cent. sodium hydroxide solution and acidifying with acidic ethyl alcohol 9.3 per cent of a grey coloured mucilage. It was found to contain 44.6% of sugars and 16.2% of uronic acid. The mucilage was hydrolysed by heating with 10% sulphuric acid solution. The hydrolysate gave the barium salt of uronic acid on treatment with barium carbonate and then ethyl alcohol and the sugar syrup from the alcoholic extracts. On analysis of the syrup by circular paper chromatography, it was found to contain glucose, xylose and rhamnose. Glucose was crystallised out and identified. Xylose and rhamnose were identified by means of specific tests and by preparing 2:3-dimethyl-xylose, m.p. 144°C. and the osazone derivatives.

The examination of the barium salt of the uronic acid obtained on hydrolysis showed that the uronic acid in the mucilage was glucuronic acid. The uronic acid on oxidation with nitric acid did not yield mucic acid; but on concentration and addition of potassium hydroxide and then acidification with acetic acid, crystals of potassium acid saccharate were obtained.

**203. Structure of the *Acacia Sundra* Gum—Nature of the sugars present and structure of the Aldobiouronic Acid.**

S. MUKHERJEE and A. N. SHRIVASTAVA, Kanpur.

The gum *Acacia sundra* (Family *Leguminosae*) was purified by dissolving it in small amount of water, acidifying and precipitating it with alcohol. Purified gum was subjected to graded hydrolysis. Mixture of sugars, so obtained, on chromatographic examination showed the presence of rhamnose, arabinose, galactose and a faint trace of xylose. This mixture was separated by cellulose powder column chromatography. L-rhamnose was identified as  $\alpha$ -l-rhamnose hydrate (m.p. and mixed m.p. 93-94°);  $(\alpha)_D^{25} + 8.6^\circ \pm 1^\circ$  and phenylosazone (m.p. and mixed m.p. 177°). L-arabinose (m.p. and mixed m.p. 156°), as phenylosazone (m.p. and mixed m.p. 163-64°),  $(\alpha)_D^{20} + 101^\circ \pm 4^\circ$ ; and D-galactose (m.p. and mixed m.p. 166-68°) as methyl-phenyl hydrazone (m.p. and mixed m.p. 182-83°),  $(\alpha)_D^{20} + 81.8^\circ \pm 2^\circ$ . The aldobiouronic acid on chromatography resolved itself into two. Aldobiouronic acid was methylated twice with dimethyl sulphate and caustic soda and four times with Purdie's reagent and was distilled in high vacuum. Fully methylated product was hydrolysed to give methylated galactose and methylated glucuronic acid. Methylated galactose was a mixture of two as found by chromatographic examination. It formed an anilide m.p. 165-66°. M.P. of 2, 3, 4 tri-O-methyl-D-galactose anilide is 165-70°. An attempt is being made to separate the two sugars by paper parti-

tion chromatography. Methylated hexuronic acid on chromatographic examination gave spot corresponding to 2:3:4 tri-O-methyl-D-glucuronic acid; its further examination is in progress. Formation of 2:3:4 tri-O-methyl-D-Galactose shows that this sugar is attached to the glucuronic acid through its position 6. Galactose portion must be linked to the glucuronic acid portion at C<sub>1</sub> (formation of 2:3:4-tri-O-methyl-D-glucuronic acid). Therefore one of the aldobiouronic acids is 6 (D-glucuronopyranosyl)-D-galactopyranose.

#### 204. Synthesis of 1:2:3:4:9:10-Hexahydro-7-methoxy-8-isopropyl-1-oxophenanthrene.

A. C. CHAUDHURI and D. NASIPURI, Calcutta.

Totarol, a tricyclic resinol, C<sub>20</sub>H<sub>16</sub>O, from wood of *Podocarpus Totara*, was given the structure as 1:2:3:4:9:10:11:12-octahydro-7-hydroxy-1:1:12-trimethyl-8-isopropylphenanthrene (I) by Short and co-workers (J. Chem. Soc., 1951, 2979) mainly on the basis of the isolation of 1-methyl-7-methoxy-8-isopropylphenanthrene (IV) from the dehydrogenation product of methyl totaryl ether. The structure of the phenolic ether was, however, not confirmed by Synthesis. In a projected synthesis of this degradation product, 3-methoxy-2-isopropylphenethyl bromide was prepared (Nasipuri and Chaudhuri, Science and Culture, 22, 117, 1956). This was condensed with ethyl 4:6-dioxoheptane-1:5-dicarboxylate and the product on cyclo-dehydration with concentrated sulphuric acid, afforded  $\gamma$ -(2-carboxy-3:4-dihydro-5-isopropyl-6-methoxy-1-naphthyl) butyric acid, (V) m.p. 196°, which on esterification and Dieckmann cyclisation followed by hydrolysis gave 1:2:3:4:9:10-hexahydro-7-methoxy-8-isopropyl-1-oxophenanthrene (VI), m.p. 60-62°. This on treatment with methylmagnesium iodide and subsequent dehydrogenation is expected to give the desired phenolic ether.

#### 205. Chemical Investigation of Indian Spices, Part I.

SACHINDRA K. CHAKRABORTI and P. K. BOSH.

A systematic chemical investigation of the non-volatile constituents of the Indian spices have been taken up. The first substance examined under this scheme was *Cuminum cyminum* (N.O. Umbelliferae) and the seeds yielded two flavone glucosides (I) and (II) and d-mannitol (III). The flavone-glucoside (I) could not be characterised. The aglucone of (I), C<sub>15</sub>H<sub>10</sub>O<sub>6</sub>, m.p. 315-18°C (d) gave a tetraacetate, C<sub>23</sub>H<sub>18</sub>O<sub>10</sub>, m.p. 226-28°C and a trimethyl ether, C<sub>18</sub>H<sub>14</sub>O<sub>6</sub>, m.p. 167-8°C. It has been found to be identical with luteolin, (5:7:3':4'-tetra hydroxy flavone). The glucoside (II), was obtained as almost colourless needles, m.p. 228-32°C. The aglucone of (II), C<sub>15</sub>H<sub>10</sub>O<sub>5</sub>, m.p. 340-45°C (d), gave a tetraacetate, C<sub>23</sub>H<sub>18</sub>O<sub>9</sub>, m.p. 182-83°C and a di-methyl ether, C<sub>17</sub>H<sub>12</sub>O<sub>5</sub>, m.p. 173-74°C. An acetyl of the di-methyl ether also was prepared, C<sub>19</sub>H<sub>14</sub>O<sub>6</sub>, m.p. 200-1°C. The aglucone was identified as apigenin (5:7:4' tri-hydroxy flavone) and the corresponding glucoside as apiin, (apigenin-7-glucoside).

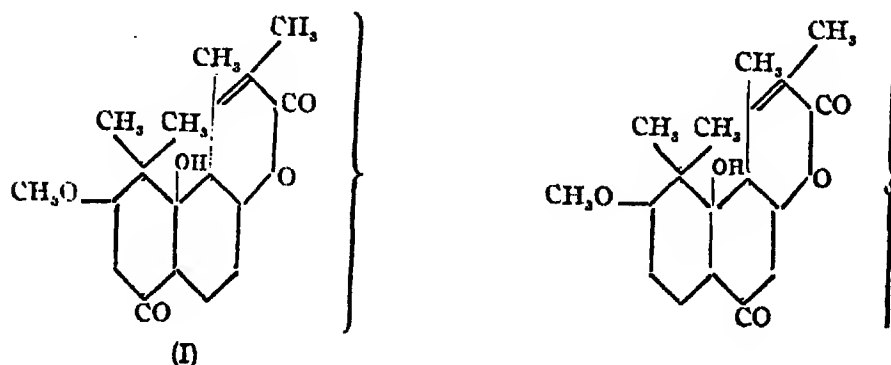
#### 206. The Constitution of Swietenine, the NonBitter Principle of the seeds of *Swietenia macrophylla* King.

ASIMA CHATTERJEE and TARAKESWAR CHAKRABARTY, Calcutta.

Earlier it has been demonstrated that swietenine, C<sub>31</sub>H<sub>50</sub>O<sub>8</sub>, the nonbitter principle of the seeds of *Swietenia macrophylla* King is an  $\alpha$ : $\beta$ -hexenolactone and carries a ketocarbonyl, two terminal methyl, a hindered methoxyl and a tertiary

hydroxyl group. This lactone isomerises with alkali giving rise to *isowietenine*  $C_{18}H_{28}O_6$ , which also contains the above functional groups, the hydroxyl in this compound being secondary. Further investigation has shown that it is a hydronaphthalene derivative and upon selenium dehydrogenation affords a polyalkylated naphthalene, *swieten*,  $C_{16}H_{20}$  (as indicated from its analysis, spectral and chemical evidences). Additional proof of this hydronaphthalene structure of *swietenine* has been secured from the isolation of two other polyalkylated naphthalenes called *isoswieten A*,  $C_{16}H_{20}$  and *isoswieten B*,  $C_{16}H_{20}$  (isomeric with *swieten* but not identical). These naphthalene derivatives are produced from *swietenine* by selenium dehydrogenation of deoxydihydrodemethyl *swietenine*, the latter being prepared from the parent lactone by demethylation followed by Clemmensen reduction.

The position of the functional groups have also been determined. Two terminal methyl groups occur in  $\alpha\beta$ -hexenolactone moiety, direct evidence of which has been available from the isolation of tiglic acid from *swietenine* during its fusion with alkali when a naphthol derivative is also obtained. Both periodic acid and lead tetraacetate do not react with *swietenine*, demethyl*swietenine* and *isoswietenine*, thereby concluding that the hindered methoxyl, ketocarbonyl, the tertiary hydroxyl group and the potential hydroxyl of the lactonic carbonyl—none of these two functions are attached to the adjacent carbon atoms. From a consideration of all the physical and chemical evidences available at hand, from an examination of the molecular model (Leybold type) of *swietenine* and from the present knowledge of biogenesis of terpene derivatives, the constitution of *swietenine* can best be represented as (I) or (II).



Both the structures can explain all the salient reactions of *swietenine* specially the hindered nature of methoxyl and hydroxyl groupings.

## 207. Chemical Investigation of *Asteracantha longifolia* Ness.

ASIMA CHATTERJEE and SUDHIR KUMAR SREEMANY, Calcutta.

*Asteracantha longifolia* Ness (Fam. *Acanthaceae*) formerly named *Hygrophila spinosa* (Beng. Kuliakhara) contains in its roots a triterpene alcohol m.p.  $213^{\circ}$  besides two other minor compounds m.p.  $245-247^{\circ}$  and  $152-55^{\circ}$ . The separation of these three constituents has only been possible by repeated chromatographic resolution. The triterpene alcohol, which analyses for  $C_{30}H_{50}O$  responds to sterol-reactions, decolourises bromine in chloroform, forms a monoacetyl (m.p.  $213^{\circ}$ ) and monobenzoyl derivative (m.p.  $256^{\circ}$ ). Upon oxidation with chromic acid by Sarett's method, it forms a ketone (A)  $C_{28}H_{48}CO$ , m.p.  $170^{\circ}$  which upon Huang Minlon variant of Wolff-Krishner reduction forms a hydrocarbon (B)  $C_{28}H_{48}$ , m.p.  $161-63^{\circ}$ .

The triterpene alcohol is finally proved to be identical with *lupeol* by direct comparison of their properties and the properties of their derivatives viz., the ketone (A) with *lupenone* and the hydrocarbon (B) with  $\alpha$ -*lupene*.

**208. Seed fat from *Saraca indica*, Linn.**

D. P. CHAKRABORTY, Calcutta.

A yellowish solid fat from *Saraca indica* Linn, melting at 75-78°C has been isolated. In the preliminary investigation the properties of the fat have been studied. The mixed fatty acids obtained from the fat after saponification and the removal of the non-saponifiable matter were examined spectro-photometrically following the method of Hilditch *et al.* The percentage of Linolenic acid, linolic acid, oleic acid, and saturated acids (by difference) have been found respectively to be 3.39, 12.86, 28.28 and 55.47.

**209. Chemical investigation of *Feronia elephantum* Corr.**

D. P. CHAKRABORTY and P. K. BOSI, Calcutta.

Marmesin ( $C_{14}H_{14}O_4$ , m.p. 189-5°) has been isolated from the bark of *Feronia elephantum*, Corr. Stigmasterol ( $C_{28}H_{48}O$ , m.p. 170°) has been isolated from unripe fruits and leaves of the plant. Traces of alkaloids are present in the leaves.

**210. Chemical Examination of leaves of *Clitoria ternatea*.**

R. D. TIWARI and R. K. Gupta, Allahabad.

From the alcoholic extrat of the leaves of *clitoria ternatea*, a white solid m.p. 85°C has been isolated. This compound is aliphatic and saturated in character. On analysis the compound was found to contain C=79.1%, H=12.9% and O=8% (by difference) which corresponds to molecular formula  $C_{12}H_{26}O$ . On acetylation it gave a mono acetyl derivative M.P. 80°C. The compound  $C_{12}H_{26}O$  was oxidised with concentrated nitric acid, when a mono basic fatty acid M.P. 71°C and molecular weight 304 was obtained.

**211. Chemical Examination of the seeds of *Clitoria ternatea*.**

R. D. TIWARI and R. K. GUPTA, Allahabad.

*Clitoria ternatea* commonly known as Aparajita has been known to be a reputed herb for the treatment of a number of diseases. The crushed seeds of this plant when extracted with rectified spirit gave a white amorphous product M.P. 80°C. The compound was aromatic in character, decolourised bromine water and contained nitrogen and phosphorus. On heating in a dry test tube it gave an offensive odour which changed to that of burnt hair on further heating. The compound dissolved in sodium hydroxide solution giving a yellow colour. On analysis, the compound was found to contain C=55.54%, H=7.81%, N=10.54%. The compound resembles proteins in behaviour and it is difficult to determine its molecular weight. On hydrolysis it gave a mixture of amino acids, which were identified to be lysine, alanine, valine, glutamic acid by paper chromatography along with 4 other amino acids which have not yet been identified.

**212. Chemical Examination of the work of *Mimusops elengi*.**

R. D. TIWARI, S. S. KHANNA and R. K. GUPTA, Allahabad.

The pet. ether extract of the stem bark of *M. elengi* left a light yellow coloured residue from which a white amorphous product m.p. 168-70°C was obtained on crystallisation with absolute alcohol. This compound is a saturated aliphatic substance.

containing C=80.78% H=12.82% which corresponds to mole. formula  $C_{11}H_{14}O$ . The compound gave an acetyl derivative m.p. 120°C. The constitution of this compound is under study.

**213. Chemical Examination of the seeds of *Psoralea corylifolia*, L., Part II—On isolation and constitution of isopsoralidin.**

S. SIDDAPPA and Y. V. SATHYABHAMA DEVI, Bangalore.

During the isolation of Corylifolean (*Proc. Ind. Sci., Cong., 1956*, 126) on a large scale from the seeds of *Psoralea corylifolia* L., a new crystalline material,  $C_{11}H_{14}O_4$  (m.p., 283-4°C) was obtained and named Isopsoralidin. It does not contain any methoxyl group and on methylation gives methylisopsoralidin,  $C_{17}H_{22}O_4$  (m.p., 186°C). On acetylation it yields a diacetate, diacetyl isopsoralidin,  $C_{23}H_{28}O_6$  (m.p., 219-220°C). Methylisopsoralidin on acetylation gives methylacetyl isopsoralidin,  $C_{17}H_{22}O_6$  (m.p., 175-176°C), thus accounting for two of the oxygen atoms in the molecule. Both isopsoralidin and methylisopsoralidin behave as lactones. On methylative cleavage with sodium hydroxide and dimethyl sulphate in nonaqueous medium, isopsoralidin gives a trimethoxy compound,  $C_{11}H_{12}O_3$  OR  $[C_{11}H_{13}O(OCH_3)_2(COOCH_3)]$ , m.p., 83-84°C. which on saponification yields a dimethoxy acid  $C_{11}H_{20}O_6$  (m.p., 172°C). The results go to show that isopsoralidin belongs to the class of coumarins. On catalytic hydrogenation it gives dihydroisopsoralidin, (m.p., 268°C), which on acetylation yields dihydro diacetyl isopsoralidin (m.p., 203-4°C) and on methylation methyl dihydroisopsoralidin. (m.p., 168-170°C). Chromic acid oxidation and ozonolysis experiments showed the presence of an isopropylidene ( $=C \begin{smallmatrix} \text{CH}_3 \\ \diagup \\ \text{CH}_2 \end{smallmatrix}$ ) or an isopropyl carbinol  $\left[ -C(OH) \begin{smallmatrix} \text{CH}_3 \\ \diagup \\ \text{CH}_2 \end{smallmatrix} \right]$  grouping in the molecule. Nitric acid oxidation yields a nitrophenolic acid,  $C_{14}H_{12}O_6N_2$ , (m.p., 152°C) and oxalic acid. The results of methylation and oxidation experiments of isopsoralidin with nitric acid have been discussed and a benzocoumarin structure has been provisionally advanced for isopsoralidin.

**214. Studies on the polymerisation of vinyl esters of aliphatic acids. Part III—Preparation and polymerisation of vinyl butyrate.**

C. J. KURIAN and M. S. MUTHANA, Kharagpur.

Vinyl butyrate ( $n_D^{25} 1.4051$ ;  $d_4^{25} 0.8932$ ) prepared by the ester interchange reaction between vinyl acetate and butyric acid—was polymerised using different concentrations of benzoyl peroxide and azo-bis-isobutyronitrile as initiators, the extent of conversion being found by direct analysis for monomer content.

The overall rate of polymerisation was found to be a linear function of concentration of initiator in both cases. The molecular weight of the polymers in all cases increased with conversion, to give high molecular weight polymers.

**215. Structure of Tukh-Malanga mucilage (*Salvia-Aegyptica*)—nature of sugars present and examination of aldobiouronic acid.**

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

Tukh-Malanga (*Salvia Aegyptica*) of the family Labiatae is a typical plant mucilage obtained from the seeds of a plant from the plains and hills of Punjab and Delhi.

The mucilage under investigation was isolated from the seeds by precipitating it from a filtered acidified aqueous solution with alcohol after intermediate formation of a copper complex. The raw and purified mucilage are soluble in water and does not reduce Fehling's solution; pentosams, 31.9 per cent; pentoses 37.1 per cent and furfural 18.7 per cent.

Purified mucilage was subjected to graded hydrolysis. Mixture of sugars so obtained, on chromatographic examination showed the presence of L-rhamnose, L-arabinose and D-galactose. This mixture was separated by cellulose powder column chromatography.

(a) L-rhamnose was identified as  $\alpha$ -L-rhamnose hydrate, m.p. and mixed m.p. 92.5°,  $[\alpha]_D^{20} +7.8^\circ \pm 1^\circ$  (C, 2.0 in water) (after recrystallisation from aqueous methanol); Methyl phenyl hydrazone, m.p. and mixed m.p. 124°, (b) L-arabinose, m.p. and mixed m.p. 156°; diphenyl hydrazone m.p. and mixed m.p. 195°; (c) D-galactose, m.p. and mixed m.p. 165°; Methyl phenyl hydrazone m.p. and mixed m.p. 182°-3°.

The aldobiouronic acid is composed of a D-galacturonic acid and a L-rhamnose unit. D-galacturonic acid was identified by oxidation to mucic acid m.p. 206°d.

To determine the structure of the aldobiouronic acid it was converted into an hepta-O-methyl derivative. Hydrolysis of the methylated product gave equal amounts of methylated sugar and acid fractions. Further work is in progress to identify each fraction.

#### 216. Chemical investigation of the genus *Ficus*. I.

AJIT K. BANERJEE and P. K. BOSE, Calcutta.

Many species of *Ficus* (Fam. Utricaceae) are widely distributed in tropical regions and are valued for their medicinal properties. A systematic investigation of various *Ficus* species has been started.

From dried bark of *F. bengalensis*, *F. religiosa*, *F. glomerata*, *F. hispida*, *F. krishna* and *F. infectoria*, some triterpenoid compounds have been isolated and identified. These are:  $\alpha$ -amyrin acetate, m.p. 224-25°C,  $[\alpha]_D = +79^\circ$  (in chloroform);  $\beta$ -amyrin, m.p. 195-96°C; lupeol acetate, m.p. 217-18°C;  $[\alpha]_D = +42^\circ$ ; epifriedelinol, m.p. 271-73°C,  $[\alpha]_D = +19^\circ$ ; and  $\beta$ -sitosterol, m.p. 137-38°C,  $[\alpha]_D = -39^\circ$ .

Alkaloids have been found to be absent. It is interesting to note that all the four representative members of pentacyclic triterpenes are present in *Ficus* species and occurrence of epifriedlinol along with  $\gamma$ -amyrin acetate is significant in the light of biogenesis of pentacyclic triterpenes.

#### 217. Chromatographic separation of glycerides.

D. K. GUPTA, B. T. R. IYENGER and M. M. CHAKRABARTY, Calcutta.

Studies have been made in the separation of glycerides by column chromatography with specially prepared activated silica gel as the selective adsorbent. Glycerides of poppy seed obtained by solvent extraction with petrol were chosen for the experiments. Silica gel mixed with 25% Hyflo super cel was packed by slurry method to 50 c.m. height in 3.5 diam. glass tube through which the oil was passed. The system was kept in CO<sub>2</sub> atmosphere. The eluant used was petroleum ether and diethyl ether in different proportions and the rate of flow was adjusted to 250 c.c./2hrs. Over 92% recovery of the oil was recorded after collecting 24 fractions varying in Iodine value from 136.2 in the original to 168.5 containing almost pure Trilinolein (I.V. 172.3). Further work is in progress.



**218. Fractionation of Myrobalan and Divi divi tannins.**

K. N. S. SASTRY and Y. NAYUDAMMA

Aqueous extract of myrobalan fruits is unstable due to the presence of enzymes, and N<sub>2</sub> and phosphorus containing substances. However extract, prepared from acetone, in water is stable. By extracting such an aqueous solution of myrobalan and divi divi tannins at different pH levels with ethyl acetate, several fractions are obtained to be used for further study.

1. Myrobalan and divi divi tannins both being hydrolysable type were subjected to ethyl acetate extraction at different pH levels in liquid-liquid extraction apparatus, from pH 7 downwards to 1, and various fractions were obtained. At pH 1, the aqueous and solvent layers submerged after a while. The acetyl derivative of myrobalan tannins at pH 7 and 4 were prepared in the usual way, which from dilute alcohol melted at 158° and 208° respectively; while those of divi divi at pH 7, and 4, melted at 206° and 186° respectively. Acetyl derivative of divi-divi at pH 2 was difficult to purify; it decomposed at 188°C. Myrob fraction at pH 7 gave with 5% sulphuric acid at 100°C, for 74 hours, a solid, after working up with ether, decomposing at 248°, and that from divi divi at 235°.

2. Ellagic acid and such other constituents were separated from myrobalan (40 g.) and divi divi (40 g.) purified extracts by suspending in (4 litres) of N/2 NaHCO<sub>3</sub>, separately, and passing moist air for 40 hours. The solid precipitates in both the cases, after acidification, did not melt below 270°. The clear filtrates are being used for further fractionation.

**219. Nature of some Indian vegetable tan materials.**

S. K. BARAT.

A simple method for studying the differential characteristics of hydrolysable and condensed tannins is described with particular reference to their stability towards hydrolysis. The method also gives a measure of the tanning potential of a particular tanstuff and affords an easy means of making comparative assessments of a number of vegetable tan materials. Results indicate that Gelatin Numbers are a useful guide to the molecular weight and size of a tannin, its resistance to hydrolysis and capacity for phlobaphene formation and should prove useful in the preparation and identification of pure tan fractions.

**220. Acetyl and Methyl derivatives of vegetable tannins.**

K. N. S. SASTRY and Y. NAYUDAMMA.

Indigenous vegetable tannins, such as Myrobalan, Divi divi, Kurada, Wattle and goran have been studied for acetylation and methylation derivatives. The plant materials either bark or nuts, were extracted with commercial acetone. The solvent is removed under reduced pressure, finally drying the extracts in vacuum (4-6 mms.) The dried extracts are treated with petroleum ether 40-60° to remove fatty materials which usually ranged about 1 to 1.5% on the dry extract basis, and then with ethyl ether, when Karada indicated very small quantity of solid material. While wattle gave a solid material about 1% on dry extract basis, which shrank at 85° and decomposed sharply at 103-104°. The dry extracts thus prepared, purified with organic solvents such as methyl alcohol, ethyl alcohol, acetone etc. to remove as far as possible, gums, sugars and such other insoluble materials. Finally the tannins were precipitated by solvents and passed through Silica gel column in acetone solution and the solvent evaporated and extract dried in vacuum. These

extracts were subjected to acetylation, using acetic anhydride and pyridine under ordinary temperature for 48 hours and the resulting products obtained. The extracts were also subjected to methylation, using either dimethyl sulphate in alkaline medium or diazomethane, or both in some cases. The acetylated compounds were all either whitish or dull greyish white. The methylated derivatives were greyish white, excepting methylated karada, wattle and goran which were reddish brown or brown. Mostly they decomposed without melting.

**221. Chromatographic examination of the amino-acids in the non-fatty matter of the seeds of—Linseed, Safflower, Niger, Sesame, Cotton, Groundnut and Coconut.**

V. G. SONAR and V. A. PATWARDHAN, Sangli.

The non-fatty matter of the seeds of Linseed, Safflower, Niger (Drying group), Sesame, Cotton (Semi-drying group), Groundnut and Coconut (Non-drying group), was analysed by the application of circular paper chromatography and the following amino-acids were found to be present in each case:—Leucine, Phenylalanine, Valine, Tyrosine, Proline, Alanine, Glutamic acid, Serine, Arginine, Histidine and Lysine. Groundnut showed the presence of Cystine; Coconut showed the presence of Tryptophan and Cystine, as additional amino-acids to the above mentioned group.

The amino-acid contents of Linseed, Safflower, Niger and Sesame appear to be in identical state. Alanine, Glutamic acid, Serine, Arginine and Histidine appear to be in identical state in all these seeds except the Coconut. Coconut contains comparatively the maximum number of amino-acids indicating its peculiarity here also. The band due to Proline in Cotton and Coconut; Cystine in Groundnut, and Lysine and Cystine in Coconut are extremely faint. The iodine value which is related to the fatty content may be correlated to the amino-acid contents by further studies on these lines in case of ripened dry seeds.

**222. Cyanine Dyes—Part I.**

BHASKAR DAS and M. K. ROUT, Cuttack.

In the present work, six thiazolo carbocyanine dyes derived from 4-phenyl-2-methyl thiazole, 4-methoxy-phenyl 2-methyl thiazole, 4-p-ethoxyphenyl 2-methyl thiazole, 4-p-bromophenyl 2-methyl thiazole, 4-p-nitrophenyl 2-methyl thiazole and 2-methylbenzothiazole have been prepared. They have been prepared in two ways—(1) by reaction with ethyl orthoformate and (2) with the help of acetanilido vinyl intermediates.

**223. Imine Dyes derived from 3-bromoacenaphthenequinone.**

PARERSH CHANDRA DUTTA and SUNIL KUMAR ROY.

Imines derived from chloro- and amino-anthraquinones are commercially important vat dyes. Attempts to prepare similar vat dyes from bromo- and amino-phenanthraquinones were made by Mukherjee and Watson (J.C.S., 1916, 617) and Desai and Kundel (J.I.C.S., 1952, 29, 238). The present communication deals with imine dyes derived from 3-bromoacenaphthenequinone. As observed in the case of phenanthraquinone, acenaphthenequinone being similarly an ortho-quinone is not found favourable for producing imine vat dyes like the paraquinones as these dyes are not much soluble in alkaline hydrosulphite and as such very light shades are obtained on cotton.

**224. Synthesis of cyanine dyes by the condensation of p-dialkyl aminobenzaldehyde with appropriate heterocyclic compounds, Part VIII.**

M. Q. DOJA and ARUN KUMAR SINHA, Patna.

The effect on sensitization of substitution in the quinaldine nuclei of p-diethylamino- and p-dimethylamino cyanines has been studied. Four new dyes have been synthesised by the condensation of p-dimethylamino- and p-diethylamino benzaldehydes with 6- formamido-, 6- acetamido-, 5-acetamido-, and 5-acetamido quinaldine ethiodide respectively. The optical, chemical, dying and photographic properties of these compounds have been examined and intermediates have been described.

**225. Studies on Indigoid dyes, Part II—Benzylidene-2-(5-Iodo) Thionaphthene.**

ARUN KUMAR SINHA, Patna.

The effect of an iodine atom when present in 5-position of the benzene nucleus of thionaphthene ring has been studied with regard to benzaldehyde series. For this purpose four new dyes have been synthesised by condensing the 5-iodothioindoxyl with benzaldehyde, p-nitrobenzaldehyde, p-dimethylaminobenzaldehyde and p-diethylaminobenzaldehyde. Their dyeing and other properties have been studied.

**226. Chemotherapeutic Dyes II.**

A. B. SEN and R. C. SHARMA, Lucknow.

The present work reports the synthesis of a number of nitrophenoxazines, containing alkyl, carbomethoxy, carbethoxy and tert amyl groupings, which would be catalytically reduced to the corresponding aminophenoxazines and tested for antitubercular activity. Such compounds have been reported to be active against Tubercle Bacilli by de Witts (J. Inf. Dis., 1913, 13, 378), Crossby et al (J. Amer. Chem. Soc., 1952, 74, 573-584; C.A. 1955, 2085), Clapp et al (J. Amer. Chem. Soc., 1952, 74, 1989-1994) and Boothryd et al (J. Chem. Soc., 1953, 1499-1508).

The nitrophenoxazines were obtained by the condensation of o-aminophenol with 2-Chloro 3:5 dinitro methyl benzoates; 2-chloro 3:5 dinitro ethyl benzoate; 4-chloro 3:5 dinitro ethylbenzoate; 4-chloro 3:5 dinitro, 1-tert. amyl benzene and 1-chloro 4:6 dinitro, 3 ethyl benzene in the medium of sodium acetate and ethanol.

**227. Catalytic Pyrolysis under Pressure of Oxygenated Aliphatic Compounds Containing Hydroxyl Groups.**

DHARAM VIR and S. K. BHATTACHARYYA, Kharagpur.

Detailed investigations into the catalytic pyrolysis of some oxygenated aliphatic compounds containing hydroxyl groups have been conducted in the temperature range of 150°-230°C and under pressures upto 6,000 psi in the presence of the iodide-silica catalysts of the I Transition Group elements. Methyl alcohol, heated in the presence of compressed nitrogen, in the temperature and pressure range indicated gives hydrogen, carbon monoxide and methane. Ethyl alcohol behaves similarly. In both cases, the effect of an increase in pressure or a decrease in temperature is to cause a decrease in total pyrolysis and to reduce the amount of all the products individually. The total conversion, on the input carbon basis, is, however, small in both cases, being maximum in case of nickel iodide-silica:

4.3% of methyl alcohol and 9.9% of ethyl alcohol at 200°C and 1,700 psi nitrogen pressure. Glycollic acid on pyrolysis gives carbon monoxide, carbon dioxide, methane, methanol, formaldehyde and hydrogen. Ethyl glycolate gives in addition ethyl alcohol and glycollic acid. The yields of all the products show pressure- and temperature-variation characteristic analogous to those observed with alcohols. With nickel iodide-silica at 200°C and 1,700 psi nitrogen pressure, the total pyrolysis of glycollic acid is 26.4%; of ethyl glycolate, the pyrolysis is 27.0%, a part of which is accounted for by the hydrolysis products. Nearly one-third of the primary products of hydrolysis are further pyrolysed to produce carbon monoxide, carbon dioxide, methane, methanol, hydrogen and formaldehyde.

**228. Studies on the application of urea adduct segregation methods to fats containing conjugated fatty acids.**

S. SINHA, S. R. CHAKRABARTY and M. M. CHAKRABARTY,  
Calcutta.

A study of the comparative tendency to urea adduct formation in the case of conjugated tetraene, triene and diene acids have been made for the first time,  $\gamma$ -Parinaric acid (9, 11, 13, 15, octadecatrienoic acid) present in *Impatiens balsamina* seed fat,  $\alpha$ -eleostearic acid present in tung oil and conjugated diene acid from dehydrated castor oil were chosen for the experiments. It has been shown that with decreasing unsaturation, conjugated acids have marked tendencies of forming adducts with urea at less concentrations of the latter. It has been shown also that the influence of higher melting point and consequent lower solubility are counter-balanced by the influences of unsaturation even in the conjugated state and the influences of m.p. and solubilities are subordinate to unsaturation.

**229. Preparation of 3:5 dibromopyridine.**

BIRESWAR BANERJEE, Calcutta.

In this paper, an improved and easy method for the preparation of 3:5 dibromopyridine has been described. It is a case of liquid phase bromination, where dry pyridine was brominated inside a two necked standard joint flask, one of the necks attached to a water condenser and the other to a long stem dropping funnel. Bromine was added to the pyridine through the dropping funnel whose stem dips into the layer of pyridine. The reaction was conducted in a graphite bath and the temperature was maintained at about 300°C. From the tarry reaction product the bromopyridine was extracted with dilute HCl. The acid solution, on being made alkaline with ammonia, precipitates the crude bromopyridine, which was further purified by sublimation at a reduced pressure.

**230. Synthesis of Lactic Acid from Acetaldehyde, Carbon Monoxide and water at high pressures.**

R. ATCHYUTA RAO and S. K. BHATTACHARYA, Kharagpur.

The synthesis of lactic acid from acetaldehyde, carbon monoxide and water, according to the equation:



has been carried out at high pressures in the temperature range of 120°-230°C in the presence of nickel iodide-silica (84:16) catalyst. The optimum tempera-

ture for the synthesis has been found to be 170°C, above and below which the conversion of acetaldehyde to lactic acid progressively falls. The conversion carbon monoxide to formic acid, which is obtained as a by-product shows a continuous rise in the temperature range studied. At a temperature of 170°C, substantial conversions are obtained at pressures as low as 4,500 psi.

### 231. Schiff's Bases from Isoniazid.

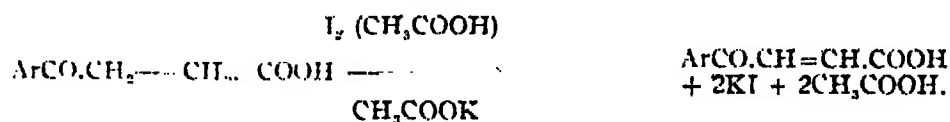
U. P. BASU and ARUN BOSE, Calcutta.

Cymermann -Craig, *et al.* (*Nature*, 1955, 176, 34) showed that isonicotinic acid hydrazide and its N<sup>2</sup>-alkylidenes are all highly active compounds against *M. tuberculosis*. Bernstein and his co-workers (*Ann. Rev. Tuberc.*, 1953, 67, 354) also found that Schiff's bases from isoniazid have activity equal to that of isoniazid itself. These observations have now stimulated preparation of several schiff's bases from isoniazid by using aldehydes, such as, formaldehyde, cinnamic aldehyde, veratraldehyde and vanillin, etc. The presence of hydroxy or methoxy group in the phenyl nucleus of the aldehyde moiety (as in veratraldehyde or vanillin) is expected to lower the toxicity of the relevant compounds. These Schiff's bases have been characterised and studies on the physico-chemical characteristics as well as the respective *in-vitro* activity against *M. tuberculosis* have been undertaken.

### 232. The preparation of $\beta$ -Benzoyl Acrylic Acids from $\beta$ -Benzoyl Propionic Acids by Dehydrogenation with Iodine and Potassium Acetate.

HARI SHANKAR MEHRA and K. B. L. MATHUR, Delhi.

The limitations of the present methods of obtaining  $\beta$ -benzoyl acrylic acids are pointed out. A new method of preparing such acids consists in reacting  $\beta$ -benzoyl propionic acids with iodine and potassium acetate in glacial acetic acid, thus:



The dehydrogenation cannot be done in alcoholic solution. Further, potassium acetate works better than sodium acetate.  $\beta$ -2:4-dihydroxy and  $\beta$ -2-hydroxy-5-methyl benzoyl propionic acids give little or no acrylic acid. The first acid gives also a high melting solid (m.p. > 200°) which is not a coumaranone-3 derivative. The ineffectiveness of the 2-hydroxy benzoyl propionic acids may be attributed to hydrogen bonding in the carbonyl group whose activity is thus essential for dehydrogenations. The following  $\beta$ -benzoyl acrylic acids have been smoothly obtained. Yields, which, can be improved, are indicated in parenthesis:  $\beta$ -Benzoyl-(55),  $\beta$ -4-Methoxy benzoyl-(60),  $\beta$ -3:4-Dimethoxy benzoyl-(57),  $\beta$ -2:4-Dimethoxy benzoyl (7). Dehydrogenations by iodine and potassium acetate thus provide a direct method to prepare  $\beta$ -benzoyl acrylic acids from  $\beta$ -benzoyl propionic acids.

### 233. Study on Isoxazoles.

B. N. MANKAD and R. M. DESAI, Vallabhvidyanagar.

In the present investigation (i) 3-methyl-5-anilo-isoxazole, (ii) 3-methyl-5-naphthyl amino ( $\alpha$  and  $\beta$ ) isoxazole as hydrochloride are prepared from the corresponding substituted amides of aceto-acetic acid.

**234. Chelate Compounds Part I. Metal chelates of  $\alpha$ -oximino derivatives of substituted amides aceto acetic acid.**

B. N. MANKAD and R. M. DESAI, Vallabhivdyanagar.

Naik, Trivedi and Mankad (J. I. C. S. 1943, 20, 384) did not take into account the possibility of intramolecular hydrogen chelates in  $\alpha$ -oximino derivatives of substituted amides of acetoacetic acid. In the present investigation by preparing the copper, nickel and cobalt chelates of  $\alpha$ -oximino (isonitroso) compounds of (i) acetoacetanilide, (ii) acetoacet-p-toluidide, (iii) acetoacet-o-toluidide, (iv) N-1-naphthyl acetoacetamide, (v) N-2-naphthylacetoacetamide, the existence of the nature of the ring, the study of the parent substances and their metal chelates, with respect to magnetic susceptibility and absorption spectra is under progress. The applicability of the  $\alpha$ -oximino compounds as analytical reagents is under investigation.

**235. Oxidation of Phenolic Compounds with Ceric Sulphate.**

N. N. SHARMA and R. C. MEHROTRA, Meerut and Lucknow.

Spencer and Duke (1954) described empirical methods for estimating phenolic compounds with ceric sulphate. Continuing our previous work, it has been shown that a large number of phenolic compounds (phenol, catechol, resorcinol, hydroquinone, pyrogallol, and naphthols) can be oxidised quantitatively to carbon dioxide and water by refluxing with ceric sulphate solutions for about forty-five minutes. The only necessary condition for the completion of the oxidation reaction has been shown to be the presence of at least 100% excess of the oxidant, otherwise longer refluxing is found to be necessary for complete oxidation. A large number of observations confirming the above conclusions have been presented.

**236. The synthesis of Cycloheptane-1:1-dicarboxylic Acid.**

G. S. SAHARIA, Delhi.

The main idea of the work described, is to study the isomerism of the cycloheptane ring. During the course of this work, it has also been possible to verify the method for the preparation of cycloalkane-1:1-dicarboxylic acids, the authenticity of which was recently questioned by Price and co-workers. It has been observed that the ring is stable only in one form and the method for the synthesis of cycloheptane-1:1-dicarboxylic acid can be well relied upon.

This synthesis has been achieved through the following series of reactions. Ethyl cycloheptylidene-cyanoacetate prepared by condensing cycloheptanone with ethylcyanoacetate was treated with potassium cyanide and the resulting product hydrolysed to give 1-carboxy-cycloheptane-1-acetic acid. Bromination of this acid by the method of Hell-Vollhard and Zelinsky gave 1-Carboxy cycloheptane-1- $\alpha$ -bromoacetic acid and subsequent hydrolysis of this furnished the corresponding glycollic acid. Finally the oxidation of this with alkaline potassium permanganate yielded cycloheptane-1:1-dicarboxylic acid.

**237. The mechanism of Benzoin condensation.**

R. J. PHADKE, STAN-VAC REFINERY, Bombay.

Benzasalicyloin, anisalicyloin and vanisalicyloin, obtained by benzoin condensation of salicylaldehyde with benzaldehyde, anisaldehyde, and vanillin, respectively, have a 2-hydroxy group (PHADKE, R. J., J. Sci. Industr. Res, 15B, (1956), 208).

This property of salicylaldehyde to act as a donor of hydrogen atom, is attributed to the ortho effect (chelation) in the molecule, which facilitates the release of proton.

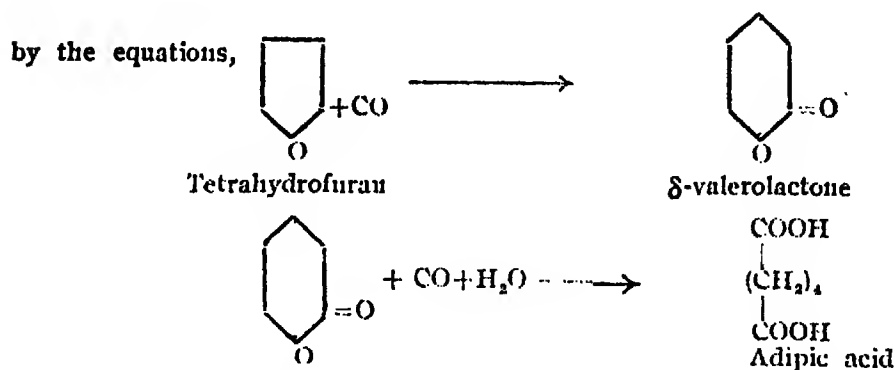
In this connection, it is interesting to observe that the non-ionic mechanism of benzoin condensation, *does not rule out* the possible formation of the 2'-hydroxy isomers, whereas, the formation of *only* 2-hydroxy isomers is well supported by Lapworth's ionic mechanism of benzoin condensation.

The non-ionic mechanism, assumes the formation of intermediate alkali cyanide additive compounds of the aldehydes, the elimination of hydrogen-cyanide, in one or other direction from which, determines the structure of the product. The ortho-effect in salicylaldehyde being ruled out with the formation of the intermediate additive compound, the non-ionic mechanism cannot be possibly decisive about the product. Lapworth's ionic mechanism, however, definitely favours the formation of the 2-hydroxy isomers for because of the ortho-effect in the molecule, the carbonyl carbon of salicylaldehyde would have an increased positive charge and the negative cyanide ion would *preferentially* add to salicylaldehyde in these condensations, yielding benzoin with salicylaldehyde as the donor.

**238. Synthesis of  $\delta$ -Valerolactone from Tetrahydrofuran and Carbon Monoxide under high pressure.**

D. K. NANDI and S. K. BHATTACHARYYA, Kharagpur.

Adipic acid, an important raw material for the manufacture of nylon can be synthesised from tetrahydrofuran, carbon monoxide and water. In order to show the mechanism of the reaction that it is a two-stage process being shown



a study has been made to prepare  $\delta$ -valerolactone from tetrahydrofuran and carbon monoxide. At various temperatures and pressures the reaction has been studied with nickel Iodide-Silica Catalyst and it has been found that optimum temperature and pressure are 200°C and 4650 psi. respectively.

**239. A Note on the hydrogenolysis of  $\alpha$ -pinene oxide; Attempted stereospecific synthesis of Methyl-Nopinols and Pinocampeols.**

R. SITA RAM IYER, Kharagpur.

This study was undertaken to establish the stereochemistry of pinocampeols and methyl-nopinols, as it is well known that epoxides, on hydrogenolysis give hydroxy groups by what may be termed as 'trans opening'. Hydrogenolysis of  $\alpha$ -pinene oxide by large excess (10 times the theoretical amount) of lithium aluminium hydride in refluxing Ether, Tetrahydrofuran and Dioxan for long periods did not yield either of the isomers of Methyl-Nopinols or any of the isomers

of Pinocampheols. In all cases the greater part of the oxide was recovered unchanged.

Reduction by palladium/carbon (10%) catalyst and platinum in absolute ethanol were also attempted. In the latter case a solid product of m.p.  $143^{\circ}\text{C}$  was obtained. The I. R. spectra shows no absorption in the range  $1500\text{--}2000\text{ cm}^{-1}$  (absence of double bond) no band in  $1100\text{--}1200\text{ cm}^{-1}$  (absence of cyclic ether linkage) strong band at  $2907\text{ cm}^{-1}$  (t-methyl) a peak at  $1379\text{ cm}^{-1}$  (C (CH<sub>3</sub>)<sub>3</sub>) and a weak band at  $2381\text{ cm}^{-1}$ .

Trevo and Brown have proposed that at least the reduction of epoxides is a case of bimolecular nucleophilic displacement proceeding by an S<sub>N</sub>2 mechanism. The actual reactant is supposed to be a complex aluminium hydride ion. Since such a mechanism requires a comparatively bigger ion than hydrogen ion, the failure of lithium aluminium hydride may be supposed to be due to the resistance offered by the molecule due to a caged structure to form the complex with aluminium hydride. Other instances where such reduction cannot be effected in case of sterically hindered oxides have been pointed out by Collin-Asselineau & co-workers by Mallein in case of 9-11 oxido steroids, Chopra et al. in case of Santonin epoxide.

Trevo and Brown assume the mode of attack of complex aluminium hydride ion and a catalyst-hydrogen complex are similar. But examples are known in which they give different products. Plattner, Heusser & Kulkarni have found that 3- $\alpha$ -Hydroxy-4 $\beta$ -5-oxido coprostane by LAH reduction gives the 3- $\alpha$ -5 $\beta$ -hydroxy-coprostane and by catalytic reduction gives 3- $\alpha$ -4 $\beta$ -dihydroxy cholestane. These results as also ours show that the mechanism of reduction by catalyst-hydrogen complex and by LAH are different.

The oxide failed to react with p-Toluene sulphonic acid also.

#### 240. Copolymerisation of ethylene with vinyl monomers. Part I.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

Copolymerisation of ethylene with various vinyl monomers have been undertaken with the aim of the possible development of these as internal plasticizers for polyethylene. The present paper deals with the copolymerisation of ethylene with vinyl acetate under pressure using benzoyl peroxide (0.1%) with respect to vinyl acetate as catalyst. In these studies the amount of vinyl acetate was always kept constant and ethylene pressure was varied. That vinyl acetate forms a true copolymer with ethylene was proved by the analysis of the different fractions of the products obtained for the vinyl acetate content in two different runs using initial ethylene pressures of 1050 psi. and 2050 psi. (In both experiments 5 ccs. of vinyl acetate containing 0.1% benzoyl peroxide was used).

Within the range studied viz., 1000 to 3000 psi. it was found that the amount of ethylene per 100 gms. of the copolymer increased linearly with pressure.

#### 241. Synthesis of Thiazoline derivatives—Part I: Action of Thiocarbanilide on various Ketones.

G. N. MAHAPATRA, Cuttack (Orissa).

In the present paper, the action of thiocarbanilide on nine ketones (acetone, ethyl methyl ketone, n-propyl and iso-propyl methyl ketone, mesityl oxide, acetophenone, o-hydroxy and p-amino acetophenone and anisal-acetone) has been studied. When thiocarbanilide is condensed with ketones in presence of iodine, the formation of 2-phenyl imino-3-phenyl-4-or-5-substituted thiazoline compounds resulted. The presence of a phenyl-imino group at the carbon atom-2 has been ascertained by hydrolysing the compound with hydrochloric acid, when a thiazolone compound



having a keto group at the carbon atom 2 resulted, along with a molecule of aniline whose presence in the filtrate was detected by the usual diazo reaction. These thiazoline compounds have been mercurated with mercuric acetate when an acetoxy mercuri group entered the phenyl nucleus attached to the imino group at the carbon atom 2. These mercurated compounds have been tested for their antibacterial as well as fungicidal properties and the results are quite promising.

#### 242. Preparation of $\beta$ -Naphthalene Sulphonyl Chloride.

C. N. V. NAMBOOTHIRY, Banaras.

Preparation of  $\beta$ -naphthalene sulphonyl chloride from sodium  $\beta$ -naphthalene sulphonate and phosphorous pentachloride has been investigated. Under Vogel's conditions ('Practical Organic Chemistry', 1954, pp. 780-781) viz., heating the reactants at 180°C for prolonged duration the yields are not very high. It has been found that by using about 25% excess of the  $\text{PCl}_5$  required and by heating only for 1-1½ hours at water bath temperature, the sulphonyl chloride can be obtained in over ninety per cent yields.

#### 243. Preparation of $\beta$ -Naphthalene Sulphinic Acid.

C. N. V. NAMBOOTHIRY, Banaras.

Sulphinic acids are generally obtained by the reduction of the corresponding sulphonyl chlorides. Zinc dust is the reagent of choice. Moist ether, alcohol and water are the various media which have been recommended in different cases. In the case of reduction of  $\beta$ -naphthalene sulphonyl chloride to the corresponding sulphinic acid, experiments were carried out using zinc dust and the above solvents. In all cases, zinc sulphinate formed was decomposed with a mixture of sodium hydroxide and sodium carbonate and the sodium salt so formed either (i) evaporated to dryness or (ii) decomposed by mineral acid precipitating the free sulphinic acid. It has been found that reduction with excess of zinc dust and water over a period of three hours, initially at 70°C and finally at boiling water temperature gave the most satisfactory results (yield, 35-40%).

In the precipitation of the free acid from the above obtained sodium salt solutions, it was found that considerable quantities of sodium  $\beta$ -naphthalene sulphonate accompanied the free sulphinic acid. The crude product was moderately dried and extracted with warm absolute alcohol, when pure sulphinic acid (m.p. 105°C) was obtained and a residue of the unwanted sodium  $\beta$ -naphthalene sulphonate left behind. From ether crystals melting at 96°C are obtained which may be due to dimorphism.

#### 244. Benzylation of the salts of certain oxyacids of sulphur.

R. H. SAHASRABUDHIY and C. N. V. NAMBOOTHIRY, Banaras.

Benylation of the salts of various oxyacids of sulphur has been tried in aqueous, alcoholic and mixed media with benzyl chloride. It has been found that at ordinary temperature with excess of the reagent thiosulphate gives an almost quantitative yield of sodium-benzylthiosulphate. The reaction can be accelerated by heating on water bath but in pure alcoholic medium with anhydrous sodium thiosulphate no benzylation took place. It is interesting to note that benzylation of sodium dithionite under analogous conditions gave the same Bunte salt as obtained from sodium thiosulphate; but the yield corresponded to only about half of the dithionite taken (cf. Fromm and Palma, *Ber.*, 1906, 39, 3308-3326). The mechanism

of this change is under further investigation. Sodium sulphite also got benzylated easily when sodium salt of benzyldisulphonic acid was obtained in very good yields. The reaction takes place very satisfactorily at ordinary temperature; heating is not necessary as recommended by earlier workers. Sodium bisulphite, sodium pyrosulphite, and sodium sulphate could not be benzylated in the like manner.

It is interesting to note that where benzylation took place only one benzyl group entered and always only a S-benzyl derivative was obtained. O-esters do not appear to be formed by this procedure.

#### 245. Benzyliothioronium Chloride as a reagent for sulphinic acids and sodium alkylthiosulphates.

R. H. SAHASRABUDHEY and C. N. V. NAMBOOTHIRRY, Banaras.

Benzyliothioronium chloride (Doulevy, *Jour. Amer. Chem. Soc.*, 1936, 58, 1004) has been recognised as a very useful reagent for the identification of carboxylic and sulphonic acids. We have found that it gives with sulphinic acids and alkyl thiosulphates, analogous derivatives with characteristic and sharp melting points. These are therefore of analytical value. Derivatives are obtained in the same manner as with carboxylic acids and sulphonic acids. With benzene-, p-toluene-, p-chloro-benzene-, p-bromobenzene- and  $\beta$ -Naphthalene- sodium sulphinates and with sodiumbenzylthiosulphate derivatives with melting points 159°, 168°, 170°, 163°, 166° and 131° respectively are obtained.

#### 246. Studies in Thiopegan derivatives.

K. S. DHAMI, H. S. SACHDEV and K. S. NARANG, Hoshiarpur.

10:11 Thiopegan derivatives having saturated thiazole part have been prepared. This has been achieved by reacting allyl isothiocyanate (I) and anthranilic acid (II) at 100-110°C when 2-thio-3-allyl-4-keto-tetra-hydroquinazoline (III) is obtained which on treatment with dry hydrochloric acid or acetyl chloride in acetic acid solution etc. gives the hydrochloride of 2-methyl 10:11 thiopegene-9, 4-one (IV). Bromination of (III) gives 2-mercapto-3 (2':3'-dibromo) propyl-4-keto-tetrahydroquinazoline (V) which undergoes ring closure to give 2-bromomethyl-10:11-thiopegene-9, 4 one hydrobromide (VI). (VI) on treatment with one molecule of alkali furnishes the free monobromo compound which with another molecule gives 2-methylene 10:11-thiopegene-9, 4-one (VII). (VII) isomerises to 2-methyl 10:11 thiopega 2:10 diene-4-one (VIII) in presence of Sulphuric Acid, Sodium Ethoxide etc. Bromination of (VII) gives the corresponding dibromo compound which with one equivalent of sodium hydroxide yields 2-bromomethyl 10:11 thiopeg-2:9-diene-4-one (IX). This has been further condensed with secondary organic bases. Reductive debromination of (IX) with zinc dust and acetic acid gives (VIII).

The above sequence of reactions has been carried out starting from 5-methyl anthranilic acid and allyl isothiocyanate with a view to prepare 5-methyl 10:11 thiopegan derivatives.

#### 247. Thiohydantoins—Part I..

B. B. PRADHAN, S. K. ACHARYA and M. K. ROUT, Cuttack.

In the present investigation, some arylidene p-tolyl-thiohydantoins have been mercurated by treatment with mercuric acetate—(a) in dilute acetic acid-alcohol medium and (b) in glacial acetic acid. The products obtained in the two cases were different. The fungicidal properties of the mercurated compounds have been studied.

**248. Search for new Insecticides—Part I : Thiocyanation of 2-amino-4-substituted thiazoles.**

G. N. MAHAPATRA, Cuttack.

In the present paper, fourteen 2-amino-4-aryl (phenyl, p-tolyl, p-ethyl phenyl, 3:4 dimethyl phenyl, p-methoxy and p-ethoxy phenyl, o-hydroxy phenyl, p-bromo phenyl, m- and p-amino phenyl,  $\beta$ -naphthyl, 2-thienyl,  $\beta$ -phenyl ethyl and  $\beta$  (p-methoxy phenyl) ethyl) thiazoles have been thiocyanated by using  $\text{NH}_4\text{SCN}$  and calculated amount of bromine as the thiocyanating agent. The position of the thiocyanate group has been ascertained to be at the 5th carbon atom of the thiazole nucleus. The possible mechanism of the thiocyanation has been discussed. These thiocyanated thiazoles have been tested for their insecticidal as well as fungicidal activity. *Aphis asclepiadis Passerni* has been used as the test insect and *Piricularia Orizae Cav.* as the test fungus. Some of the results obtained are quite promising.

**BIOCHEMISTRY****249. Studies on Vitamin A in solution.**

SUKHAMOY BHATTACHARYA and U. P. BASU, Calcutta.

Previous observation shows (Bhattacharya and Basu, *Jour. Indian Chem. Soc.*, 1954, 31, 241) that metals in general are deleterious to the keeping property of Vitamin A in oil solution, irrespective of the chemical form of the vitamin. The usual anti-oxidants in oil systems are more or less effective in protecting the vitamin A in presence and absence of metals.

It is therefore of interest to study the influence of antioxidants and metals on the stability of vitamin A in aqueous dispersion. The accelerated method of destruction of vitamin A at an elevated temperature of  $100^\circ\text{C}$  was quite rapid and the time taken for the loss of 50% activity was too short. As such a lower temperature ( $70^\circ\text{C}$ ) has been selected for this investigation.

Results at  $70^\circ\text{C}$  show that tocopherol (0.1%) helps in the keeping property of vitamin to a considerable extent, 0.05% propyl gallate being still better. Lower (0.005%) and higher (0.3%) amounts of propyl gallate accelerate destruction. Similarly citric acid (0.1%) destroys vitamin A quite rapidly.

Contrary to the observation in oil medium copper (1 to 5 p.p.m.) and 2 p.p.m. of iron are not deleterious to the vitamin. Higher quantities of iron (10 p.p.m.), however, destroy vitamin A rapidly. Citric acid which deactivates metal in oil system, accelerates the destruction to a great extent when added in combination with 2 p.p.m. of iron.

**250. Defatted Mustard Seed-cake in the Microbial synthesis of Vitamin B<sub>12</sub>.**ANADI NATH CHATTERJEE, PABITRA KUMAR MAITRA,  
S. GANGULY and S. C. ROY, Calcutta.

In a previous communication it was observed that shrimp powder can be a good substitute for distiller's soluble as the source of organic nitrogen for the production of vitamin B<sub>12</sub> by *Streptomyces olivaceus* (NRRL-B-1125) in a medium supplemented with 1% glucose and 2 ppm  $\text{Co}^{++}$ . In the present investigation amongst other nitrogenous materials from indigenous sources studied, defatted mustard oil-seed cake, has been found to give a yield of  $0.65\ \mu\text{g}$  of cyanocobalamin\* per ml. of the fermentation broth, as determined by the assay methods with *Escherichia coli* mutant, *Lactobacillus leichmannii* and *Ochromonas malhamensis*. The results obtained from fermentation conducted on a rotary shaker, have been reproduced fairly well in a ten-litre aerobic fermentor under submerged growth conditions.

**251. Synthesis of riboflavin and a riboflavin-like compound by a bacterium of the *Pseudomonas* species.**

AMIYA KUMAR HAZRA, NILIMA MAZUMDAR, S. GANGULY and  
S. C. ROY, Calcutta.

A bacterium of the *Pseudomonas* species recently isolated in this laboratory was found to produce riboflavin in quite good amounts (250  $\mu$ g per ml. of fermented broth). A study of the metabolism of this bacterium harvested on a medium consisting essentially of glycerol as the carbon source and diammonium acid phosphate as the nitrogen source revealed that another riboflavin-like fluorescent material was produced in the same fermentation broth for riboflavin and identified by the chromatographic and bioautographic techniques and which was distinct from the vitamin in respect of its chromatographic behaviour, electrophoretic mobility, absorption maximum at 260 m $\mu$  and intense blue fluorescence in ultraviolet. The compound has been obtained in a pure state by solvent partitions and alcohol precipitations, and has been found to possess one-tenth the growth promoting activity of synthetic riboflavin towards *Lactobacillus casei*.

**252. The Study of Vitamin C of Citrus fruits of Darjeeling Area.**

SATYA RANJAN SARKAR, Darjeeling.

The paper deals with the study of Vitamin C of the following Citrus Fruits e.g. Orange (*Citrus reticulata* Blanco), Lemon (*Citrus aurantifolia* Swingle), Mosambi (*Citrus Sinensis* (L.) Osbeck), and Jamir (*Citrus Limon* (L.) Bruu. f.), of Darjeeling and neighbouring areas of Sikkim.

Oranges in the green stage show lowest vitamin C, then increase becomes maximum in the about to ripe stage when they are not much sweet and diminishes slightly when full ripe and much sweet.

In general oranges of Sikkim Area contain more vitamin C than those of Darjeeling, and show higher values than the same of Coonor. Lemon contain rather low vitamin C than the same of Coonor. Mosambi and Jamir contain varying values of vitamin C.

**253. The Study of Vitamin C of Some Fruits and Vegetables of Darjeeling Area.**

SATYA RANJAN SARKAR, Darjeeling.

The paper deals with the study of Vitamin C of the following fruits and vegetables e.g., Amla (*Phyllanthus emblica*), Guava (*Psidium guajava*), and some special varieties of Green Chillies (*Capsicum annum*) of Darjeeling and neighbouring areas of Sikkim.

Red chillies contain more vitamin C than green ones and possibly, the above varieties have not been analysed elsewhere in India. The Amla and Guava of Darjeeling and Sikkim areas are found to contain more vitamin C than the same of other parts of India.

**254. Studies on *Phyllanthus Emblica* (Amla) as a readily utilizable natural source of Vitamin C.**

H. D. BRAHMACHARI and C. B. SHARMA, Pilani.

The edible portion of "Amla" was found to contain 783.8 mgms. of Ascorbic Acid per 100 gms., as determined by the 2:6 dichlorophenol-Indophenol-visual titration

method. Fresh and stored "Amla" was found to contain almost no dehydroascorbic acid, but was found to contain 7 mgms. "Reductones" per 100 gms. of the edible portion as determined by the formaldehyde condensation method. The total ascorbic acid content of Amla as determined photometrically after condensation with 2:4 dinitrophenyl hydrazine was found to be 776.0 mgms./100 gms. of the edible portion. The whole fruit or a sundried powder of the edible portion could be easily stored for more than a month in the cold season without any significant loss of its ascorbic acid content.

The availability of the Vitamin C of Amla to the human system was compared to that of crystalline Ascorbic Acid (B.D.H.) and it was found that the Blood levels of ascorbic acid and its urinary excretion after oral administration of a fixed quantity of analysed sundried Amla powder were almost similar to those after a oral "test dose" of equivalent amount of crystalline Ascorbic Acid. Groups of guinea pigs kept on equivalent amounts of Vitamin C from Amla and crystalline Ascorbic Acid mixed with ascorbutic diet—produced similar growth response.

#### 255. Nutritional deficiencies in Mosambi gardens.

D. BAP REDDY and T. SESHAGIRI RAO, Hyderabad-Dn.

Complaints of mosambi trees dying at an age of 10-12 years are being received more frequently from Telengana region of the State. Two orchards, one at Narsingi, Hyderabad district and the other at Pargi, Mahaboobnagar district were examined. The major symptoms exhibited were the general sickly appearance of the trees, heavy bearing with small sized fruits, chlorotic leaves, small leaves, partial drying up of some twigs, premature dropping of fruits and in advanced stage shredding of roots.

The affected trees at Narsingi responded very well to the application of ammonium sulphate coupled with copper spray, in the form of Bordeaux mixture. Copious irrigation also helps greatly in the revival of Mosambi trees. At Pargi the response was to the application of Magnesium in the form of 0.5% spray of magnesium sulphate four times at 10-15 days interval together with application of 2 ozs.  $MgSO_4$  to the soil per tree. Analysis of the affected leaves showed magnesium deficiency. Combination sprays of magnesium sulphate (0.5%) and copper sulphate (0.5%, neutralised) gave a very good response also, indicating that the orchard was suffering definitely from magnesium deficiency with a possible deficiency of copper. Old and neglected mosambi orchards are more susceptible to the deficiency of nitrogen, magnesium and copper.

#### 256. A Crystalline Complex between Phosphomolybdic and Folic Acids.

P. P. NAIR and N. G. MAGAR, Bombay.

A crystalline complex of phosphomolybdic acid with folic acid is described and its mode of formation indicated. To a saturated solution of folic acid in glacial acetic acid (Mercks. G.R.) is added gradually a solution of pure phosphomolybdic acid in glacial acetic acid ( $1 \mu$  mole/c.c.) and centrifuged. The clear supernatant liquid is discarded and the complex dried under vacuo. The complex is found to depress the total W.B.C count in albino rats. The results are considered significant in that this complex may be tried on experimental animals under conditions where an essential leucopenia is desired.

**257. Analysis of Tea with special reference to its selereides.**

PROMODE K. SANYAL, Calcutta.

Recently much controversy has arisen with the present legal standard of Tea, and new standards have been prescribed changing the minimum standard of water soluble extract from 30 per cent to 35 per cent and fixing the maximum limit of crude fibre content at 15 per cent, mainly to limit the stalk in tea.

The planters, however, expresses the view that, when stalk is not injurious to health and when it is a part and parcel of tea, there should be some variety of stalky tea. When the plucking of the short is extended to include more leaves, say the bud and next three leaves and the intermediate stem, more stalks are expected in the prepared tea.

Chemical analysis of different parts of the short shows that the buds and the trichomes (hairs) of the tea leaves contain the highest percentage of caffeine ranging from 3.5 per cent to 4.5 per cent. The percentage of caffeine decreases from the 1st to the 3rd leaf. The upper stem contains about 2.8 per cent of caffeine while the lower stem contains about 1.5 per cent of it. Tea prepared from a bud and two leaves yields more caffeine and volatile oil than a tea which has been prepared from the plucking of a bud and leaves.

In stem and stalk of the tea plant plenty of selereides are found. It is suggested that, if quantitative microscopy is carried out fixing the number of selereides in tea, then a better and more accurate result is expected for limitation of stalk in tea than the crude fibre method.

**258. A chemical method of estimation of Bound Nicotinic Acid (BNA) in rice bran.**

M. L. DAS and N. C. GHOSH, Calcutta.

A method of colorimetric estimation of the bound form of nicotinic acid (BNA) in the presence of free nicotinic acid in rice bran has been described. The coloured compound formed by BNA with cyanogen bromide and PABA (p- amino benzoic acid) is not extractable with n-amyl alcohol whereas the colour produced by free nicotinic acid is extractable with n-amyl alcohol. The difference in the nicotinic acid values obtained in the extracts of rice bran, before and after hydrolysis with alkali, gives the true value of BNA in terms of nicotinic acid. Our data show that the rice bran contains nicotinic acid mostly in the bound form and only a very small amount of free nicotinic acid. From the recovery experiments it has been found that 95—100 per cent of nicotinic acid added to the extracts has been recovered.

**259. Estimation of percentage of serine residue in crystalline isoelectric Egg-albumin by potentiometric titration with Glycero and Ortho-Phosphoric acids respectively.**

C. S. NARWANI and V. G. SOHONI, Bombay.

Potentiometric titrations of 100 cc of 1% aqueous solution of an isoelectric crystalline egg-albumin (prepared from fresh eggs of hen) against 0.088 M. Glycerophosphoric acid and Ortho-phosphoric acid respectively have been carried out at 35° C, adding from 0.2 to 2.2 millimoles, using hydrogen-electrode and slide-wire potentiometer, reading to 0.4 millivolt. Plots of H ions bound against

pH in case of both the acids have two maxima, one at higher pH corresponding to maximum ionisation of the protein and the other at lower pH corresponding to combination of the acid at the—OH group of the serine residue. From the results (1) gram-equivalent weight of the protein and (2) the percentage of the serine residue in the egg-albumin has been calculated which nearly agrees with the value obtained by per-iodate method.

#### 260. Amino Acid composition of Cashew Nut Globulin.

N. SUBRAMANIAN, M. V. LAKSHMINARAYAN RAO and  
M. SRINIVASAN, Mysore.

Of the World's production of cashew nuts, most of it comes from India. As a dollar earner, cashew nut is important to India's economy. It has this status because it is delicious in taste and nutritionally rich. The biological value of the cashew nut protein has been reported to be 77. Apart from a single study on the nitrogen distribution, as determined by classical methods, of its globulin (anacardein), the amino acid composition of this protein does not appear to have been studied so far. As part of a programme of work on the composition and nutritive value of protein-rich foods being carried out at the Central Food Technological Research Institute, Mysore, we have determined by buffered paper chromatographic quantitative procedure the amino acid content of the globulin isolated from cashew nut. The values (g amino acid/100 g protein) are: Cystine 1.02, Lysine 3.32, Histidine 1.81, Arginine 10.30, Aspartic Acid 10.78, Serine 5.76, Glycine 5.33, Glutamic acid 28.00, Threonine, 2.78 Alanine 3.18, Tyrosine 3.20, Valine 4.53, Methionine 1.30, Phenylalanine 4.35, Isoleucine and Leucine 11.93. Proline could not be estimated due to poor colour development at the concentration of the protein hydrolysate used in the present study and tryptophane has to be determined separately using an alkaline hydrolysate. Methionine, among the essential acids estimated, seems to be the limiting amino acid.

Procedural details will be presented and results discussed.

#### 261. Poppy Seed Proteins.

M. N. SATYANARAYANA, M. V. LAKSHMINARAYANA RAO,  
M. SRINIVASAN and V. SUBRAHMANYAN, Mysore.

Poppy seed is an oil seed obtained from the same plant *Papaver somniferum* L. from which opium is derived. Analyses of the seeds, four genuine varieties in addition to the locally available material show that proteins form the second major constituent (40% in the fat free meal) next to the oil. The study of the nutritive quality and nature of the proteins is the subject of this paper. The biological value and digestibility coefficients are  $57.9 \pm 2.0$  and  $81.1 \pm 1.0$  respectively. The protein efficiency ratio of the autoclaved seed meal (at 15 pounds per square inch for 15 minutes) determined by the rat growth method is  $1.47 \pm 0.028$  (10 d.f.) and is not much different from  $1.49 \pm 0.028$  which is the value for the seed meal as such, indicating the absence of any proteolytic inhibitor. Also, the normal growth registered by rats over a period of eight weeks and beyond on diets based on the seed flour proved the absence of any harmful constituent in the seed. Globulins form the bulk of the proteins. The determination of the amino acid composition of the total proteins and of the isolated pure globulin is near completion and will be presented.



**262. Role of Carbon Dioxide in Citric Acid fermentation. II. Effect of CO<sub>2</sub>-tension on the production of Citric Acid.**

P. K. BHATTACHARYYA, J. R. VAKIL and M. DAMODARAN, Poona.

Tracer work with C<sup>14</sup>O<sub>2</sub> has demonstrated that substantial amounts of carbon dioxide in the atmosphere above fermenting *Aspergillus niger* take part in citric acid formation under suitable conditions. The tension of carbon dioxide above a fermenting medium is expected, therefore, to influence citric acid production. Experiments with varying CO<sub>2</sub>-tensions were carried out to determine whether this was the case.

Carbon dioxide was removed from the atmosphere above fermenting cultures (i) by suspending a beaker containing NaOH or KOH above the mycelium and (ii) by passing continuous streams of atmospheric air or CO<sub>2</sub>-free air through the culture flasks. It was observed that the rate of citric acid production was appreciably reduced in all these experiments, although carbohydrate utilization and mycelial growth were affected to a much lesser degree.

In a second series of experiments inoculated culture flasks were enclosed in glass vessels containing varying amounts of carbon dioxide. It was concluded from these experiments that initial CO<sub>2</sub>-concentrations from 0.1 to 0.5% increased the rate of citric acid formation, carbohydrate utilization and growth. Carbon dioxide concentrations of 1% and above, however, retarded all these processes.

The significance of these findings in the light of metabolic reactions leading to the synthesis of citric acid is discussed.

**263. Comparative Studies on Invertase Activities of Honey and Yeast.**

M. M. BISWAS, Calcutta.

165 gms honey was mixed with 16.5 c.c. toluol and 250 c.c. distilled water and the mixture kept at 37°C for 4 days. The mixture was then diluted with 250 c.c. distilled water and filtered with kieselguhr. The volume of the filtrate was adjusted to 500 c.c. Activity of the three enzymes saccharase, inulase and raffinase in this filtrate was determined. Yeast invertase filtrate was prepared in a parallel way and 165 gms brewer's yeast powder gave 85 c.c. filtrate. Activity of saccharase, inulase and raffinase of this filtrate was also determined. A comparative study of invertase activities of honey and yeast was made. The distribution ratio of the three enzymes, saccharase, inulase and raffinase in honey was found to be 1.0:1.3:1.03 and that in yeast 1.0:0.32:0.22. Thus the proportion of saccharase in honey is rather low as compared with that of inulase and raffinase whereas the proportion of saccharase in yeast is appreciably high as compared with the other enzymes.

**264. Determination of Amylose and Amylopectin content and specific rotation of different Starches.**

R. D. PATEL, R. P. PATEL and R. S. PATEL, Anand.

According to the method of Bates, French, and Rundle for the determination of amylose content in the raw starch, the amylose content of sixteen different cereal and pulse defatted starches has been determined. The values for amylose content of starches are:—Bavato, 5.21, Kodari 6.1, Wheat 5.98, Rice 5.9, Jowar 6.8, Bajari 6.1, Lang 5.8, Wal 5.1, Tuver 5.3, Mag 5.8, Chana 5.75, Math 5.4, Chola 5.29 and Vatana 5.8. It is observed that cereal starches are rich in amylose content.



With improved calcium chloride method the specific rotation value of seven different starches derived from pulses have been determined. The specific rotation values differ very slightly from the standard value  $200^\circ$ , suggested by Clendenning and Wright.

**265. Oxidative Enzymes and Phosphatases in Agave Vera Cruz Mill.**

A. NAGABHUSHANAM, K. S. SRINIVASAN and M. SRINIVASAN, Mysore.

Peroxidase, catalase and phosphomonoesterase activity in *Agave Vera Cruz* Mill has been investigated. A high peroxidase activity is shown to be present in the *press* juice of the stem and a thirty-fold purification of the enzyme has been achieved. Catalase activity has been shown to be present in the *press juice*. The phosphomonoesterase activity in the crude juice and purified preparations show two pH optima, one between 3.0 and 3.5 and the other 5.5 to 6.0.

**266. The digestibility of crude, refined and hydrogenated Cottonseed Oil.**

M. NARAYANA RAO and S. KUPPUSWAMY, Mysore.

The *in vitro* digestibility of crude, refined and hydrogenated cottonseed oil, refined groundnut oil, and cow's ghee (clarified butter fat) was studied using castor and pancreatic lipases. Among all the fats cow's ghee was most rapidly digested. The rate of digestion of other fats was nearly the same. The coefficient of digestibility of crude, refined and hydrogenated cottonseed oil, refined groundnut oil and cow's ghee was determined using adult albino rats. The digestibility was found to be of the order of 95% in all the cases.

**267. Seed fats of the Euphorbiaceae family—Part II.**

M. M. CHAKRABARTY (Calcutta) and S. SARKAR (Jealgora).

The seed fat composition of two members of the Euphorbiaceae family, viz., *Bischofia javanica* Blum (Eng.—Bishop wood, Bengali—Kaanjal and *Antidesma diandrum* Roth (Bengali—Multa) has been examined by modern methods. The component fatty acids of *B. Javanica* consisted of 50.98% Linolenic, 11.82% of Linoleic, 23.44% oleic and 13.76% saturated acids while those of *A. diandrum* were composed of 47.53% Linolenic, 13.91% Linoleic, 13.11% oleic and 25.45% of saturated acids. The oil content of seeds were *B. javanica*—21.4%, *A. diandrum*—10.2%. Possibility of the *B. javanica* oil in the surface coating industry has been discussed.

**268. Studies in the storage of Coffee.**

K. M. NARAYANAN, C. P. NATARAJAN and D. S. BHATIA, Mysore.

The peroxide value of freshly roasted coffee, stored roasted seeds and powder have been determined. The peroxide value of the freshly roasted coffee was found to vary from zero to 8.2 millimols/kg. fat. The need for eliminating interfering constituents in the determination of peroxide value by Lea's method is indicated. No Correlation seems to exist between staleness and the development of peroxide. The oil extracted from freshly roasted coffee is more stable as compared to that obtained from the stale or green coffee powder.

**269. Detection of adulteration of animal fat in ghee by critical temperature of dissolution.**

OM PRAKASH, A. C. GUPTA and S. RAI, Kanpur.

Critical temperatures of dissolution (C.T.D.) using equal volume of solvent (a mixture of ethyl alcohol 95% and Isoamyl alcohol 2:1 by volume) have been determined on samples of ghee from different regions of India and also that of samples of tallow. Presence of free fatty acids lowers the C.T.D. and hence the method has been modified by the authors, according to which C.T.D. is found out after extracting the sample with ethyl alcohol (95%). C.T.D. of genuine ghee after extraction with alcohol have been found to lie between 49.5 and 53.5 for corresponding R.M. of 36.9 and 23.6 and B.R. Reading at 40°C, 39.6 and 43.2. The C.T.D. for Tallow was found to be 73.0 or over. Adulteration of animal fat to the extent of 10% can be detected by this method.

**270. Detection of adulteration of ghee with Vanaspati—Part II : Some further experiments.**

H. S. R. DESIKACHAR, M. V. PATWARDHAN, L. V. L. SASTRY,  
M. SRINIVASAN and V. SUBRAHMANYAN, Mysore.

The problem of detection of a hydrogenated fat (Vanaspati) in ghee was described and discussed earlier (see Subrahmanyam, V., Srinivasan, M. and Bhalarao V.R. J. Sci. industr. Res. 1952, 11A, 277). The exacting requirements of a visible colour as an additive and the inadequacy of the hitherto known edible colours to meet these requirements led us then to suggest phenolphthalein as a latent colour. Our work on this aspect was confirmed as in fact it has been extended to the use of thymolphthalein by the National Chemical Laboratory, Poona (J.S.I.R. 1954 13 B, 382). As the addition of these drugs to an article of diet like Vanaspati cannot get a clean bill of fare till definitely proved to be innocuous to the human system by repeated and prolonged experiments, the problem still remains open and calls for further experiments. The present paper describes the results of some of these further experiments.

Addition of amino acids or their esters, it has been found, does help in that they can be detected by the ninhydrin reaction, but they can all be removed by treatment of the fat with Fullers earth or animal charcoal and hot filtration, a common and so far insuperable disadvantage preventing the use of visible colours. Of the tests based on the differences in the physical properties of ghee, Vanaspati and of their mixtures turbidity temperature measurements seem to be the least inadequate mode of approach. Of a number of new solvent systems tried, (i) benzyl alcohol and glycerine and (ii) ethyl alcohol and toluene seem to hold out promise. Details of the procedure based on these solvent systems will be described and results with test mixtures and the present limitation of this tentative method will be discussed.

Certain modifications carried out of the Bandoin test, based on the addition of anti-oxidants, with a view to stabilising sesamol (component in sesame oil breaking down to sesamol to give the Bandoin colour reaction) will be described.

**271. Structure of Cordyceps Acid.**

R. CHATTERJEE, K. S. SRINIVASAN and P. C. MAITI, Calcutta.

The fungus *Cordyceps sinensis* (Berkeley) Saccardo belongs to the genus with characteristic parasitic habit on larvae and pupae as well as on insects. The species has long been regarded as a Chinese drug for tuberculosis. Brewster and

Alsberg (*J. Pharmacol. and Exptal Therap.*, 1917-18, 10, 277) has recorded that an aqueous solution of the fungus is acidic and the neutralised solution is toxic.

The species *C. militaris* (*J. Chem. Soc.* 1951, 2299) has yielded an antibiotic, cordycepin,  $C_{10}H_{13}O_5N_2$ . The present Chinese species has, however, yielded a non-nitrogenous acid,  $C_7H_{11}O_6$ , which has been called cordycepic acid. The acid has been isolated in 7% yield, from the defatted fungus, as transparent, highly soluble crystalline solid. Its solution is acidic to litmus, and sweet to taste.

Cordycepic acid is an optically active,  $\alpha_D +6^\circ.8$  (Water), monobasic acid, m.p.  $168^\circ$ , which has been found to be isomeric with quinic acid, m.p.  $162^\circ$ ,  $\alpha_D -42^\circ.1$ . It forms a monomethyl ester, a crystalline tetra-acetate and a tetrabenzoate, indicating that like quinic acid it is tetrahydroxy acid. It responds to Molisch's test and forms an acetone compound. It, therefore, behaves like a carbohydrate, and in fact takes up two molecules of periodic acid, showing as one of the possibilities the presence of 1:2:3-trihydroxy system in its molecule. Over and above this, periodic acid oxidises cordycepic acid to a compound (probably a dialdehyde which is not isolated) which on further oxidation with bromine, yields citric acid, locating the fourth hydroxyl group in C, to which the carboxyl group is attached. The structure of cordycepic acid is, therefore, 1:3:4:5-tetra-hydroxycyclohexanoic acid.

The Stuart model indicates quinic acid to be of *cis*-structure, where the carboxyl group in position 1, is *cis*-with the hydroxyl group in either of the positions, 3 and 5. Cordycepic acid differs from quinic acid, for its carboxyl group is *trans*-to the hydroxyl group either in 3 or 5; and unlike quinic acid it does not form a lactone.

**272. Metabolic studies with 1-p-bromo-phenyl-2:4-diamino 1:6 dihydro-6:6 dimethyl-1:3:5-triazine.**

H. L. BAMI, Delhi.

Metabolic studies with N<sup>1</sup>-p-bromophenyl-N<sup>5</sup>-isopropyl-biguanide hydrochloride (I) in monkeys led its conversion into 1-p-bromophenyl-2:4-diamino-1:6 dihydro-6:6-dimethyl-1:3:5 triazine (II) (Bami, *Ind. J. Med.*, 1, 283, 1953). This triazine derivative was also synthesised and proved highly active as an antimalarial (Carrington *et al.*, *J. Chem. Soc.*, 1017, 1954; Hewitt *et al.*, *Amer. J. Trop. Med. & Hyg.* 3, 225, 1954, Bami, *J. Sci. & Ind. Res.*, 14 C., 231, 1955). In order to study the metabolic breakdown of (II) itself, the compound was fed orally to monkeys at 30 mgms. base/kg.b.w., and the urine and faeces suitably extracted with butanol both at neutral and acidic pH. In every case, only (II) was isolated and there was no evidence of formation of a biguanide fragment or the isomeric 2-p-bromoaniline-4-amino-1:6-dihydro-6:6 dimethyl-1:3:5-triazine (III) to which (II) is otherwise readily converted. Butanol extracted material was also reacted with *p*-phenylazobenzoyl chloride and the mixture separated chromatographically (Crounse, *J. Org. Chem.*, 16, 492, 1951). Triazine (II & III) were not benzoylated while the presence of simple alkyl and/or arylamine fragments as possible breakdown products of (II) was also not confirmed. Apparently the triazine (II) undergoes very little breakdown *in vivo*.

**273. Influence of Chemical factors of waters on Anopheline Larval growth.**

C. ANANDARAMA RAO, Calcutta.

1. The importance of water analysis in relation to investigations regarding breeding places of mosquitos has been studied in general by Waddell, Williamson, Hackett, White and others.

2. The relation of Hydrogen-ion-concentration of waters on the carrier Anopheline larval breeding has been studied by the author (I.S.C. 1938) and it was found that breeding of larvae takes place freely in waters of pH range from 7.4 to 8.0 and that there appeared to exist a rather remote relationship between pH of waters and the larval intensity.

3. The role of other Chemical factors on the breeding of anopheline larvae in waters is studied in this paper.

4. It is found, by analytical results of several samples of waters examined, that fairly high ammoniacal figures and high oxygen absorption values have a tendency to promote the breeding, while other analytical factors do not seem to have much significance.

#### 274. 4-p-Methoxystyryl-2-aryl amino Thiazoles and their fungicidal action.

BIPIN BIHARI PRADHAN and M. K. ROUT, Cuttack.

In the present investigation, the effect on fungicidal activity of a p-methoxystyryl group in 4-position of the thiazole nucleus in thiazolyl amines has been examined.

#### 275. On the antifungal action of some natural coumarins.

D. P. CHAKRABORTY, A DAS GUPTA and P. K. BOSI, Calcutta.

Although many coumarins are known to possess physiological activities of a varied nature, the anti-fungal action of natural coumarins does not seem to have been studied. We determine the antifungal properties of 15 natural coumarins using *Curvalaria lunata* and *Aspergillus niger* as the test organisms. Generally the coumarins were more active against *C. lunata* than *A. niger*, when concentrations were the same. Psoralen, seselin and luvangetin were found to be the most active among the group of coumarins. Relation between antifungal activity and structure is discussed.

#### 276. Studies on the growth characteristic and the respiratory metabolism of *Leishmania Donovanii* in presence of different carbohydrates.

S. R. GUHA and J. J. GHOSH, Calcutta.

*L. donovani* grown on Ray's solid medium (Ind. J. Med. Res. 20 335, 1932) was used as source of culture for the present investigation.

In order to find out a correlation between the growth characteristic and the metabolic activities of *L. donovani*, the rate of glucose oxidation at different stages of the growth of the culture was measured by Warburg's manometric technique. 48 to 72 hours' culture was found to be metabolically most active.

While measuring the oxygen consumption by *L. donovani* in presence of different carbohydrates, it has been found that *L. donovani* can metabolize most of the carbohydrate compounds in the following order: glucose, fructose, mannose, sucrose, glucosamine, galactose, ribose, glycerol, and arabinose. On the other hand, lactose, maltose, corbose, xylose, sorbitol and mannitol are not at all oxidized by *L. donovani*. The high rate of sucrose utilization by *L. donovani* seems to be very interesting.

**277. Micro-fertilizer for increasing bacterial activities and stimulating crop production.**

N. V. JOSHI.

Crop production in Indian soils is very low and attempts to increase the fertility of Indian soils and as a consequence their crop producing power are being made by many agricultural scientists. In this connection our attention was drawn to some proprietary preparations which are claimed to give high yields of crop by improving the health of plants, by supplying micro-nutrients, by increasing micro-biological activity in the soil and by acting as direct manures.

We have attempted to study the claims of one of the preparations for its ability to increase microbiological activity by studying its action on (1) the number of bacteria, (2) Decomposition of carbonaceous material, (3) Nitrifying activity, (4) Nitrogen-fixing power in the soil and trying to correlate these activities with crop production in pot culture experiments. The results of these experiments are presented in this paper.

**278. Significance of multiple pathways in adaptation : III. Terminal respiratory cycles of *Aspergillus niger*.**

S. K. BOSE, Calcutta.

The spores of a given strain of *A. niger* were exposed to the action of methyl violet, which inactivates most of them. The few that survived this treatment showed progressively diminished respiration with increased doses of exposure. This progressive inhibition ultimately attains a constant value independent of the dose of exposure given. This may be taken as an indication that more than one respiratory cycle may operate in the given mould. The pattern of inhibition of respiration as induced by previous exposure to other phenyl methane dyes eg. crystal violet and malachite green bears additional evidence in support of the view as referred to above. Subsequent studies on the inhibition of respiration of normal spores not previously exposed to anything whatsoever indicate that complete inhibition may however be obtained in presence of malonate, but not in presence of trans-aconitate where partial but constant inhibition, irrespective of the concentration of the inhibitor is again obtained. This may indicate that more than one biochemical path may be involved in respiration and that this multiple mechanism is not an inductive process caused by previous exposure, but a normal one in the physiological make-up of the mould.

**279. Antibacterial activity of some heterocyclic organic sulphur compounds. Part I—Thiohydantoins, Thiazoles and Thiazolidones.**

H. K. PUJARI and M. K. ROUT, Cuttack.

Several derivatives of thiazolidones, thiohydantoins and thiazoles have been studied for their antibacterial activities in vitro against two organisms—*Staphylococcus aureus* and *E. Coli*. A relationship between structural change and antibacterial action has been attempted. In each series, the mercurated derivatives have been found to possess the maximum activity.

**280. Possible role of insect cuticular wax in defence mechanism of insects towards insecticides like DDT.**

A. S. SRIVASTAVA, Kanpur.

Many workers have already noted that some insects show different susceptibility when exposed to synthetic insecticides at different periods of the year. For

instance, in certain cases under a very low temperature of the surrounding atmosphere a greater mortality was noted with DDT in comparison to what is obtained under conditions when the temperature was comparatively higher. Such variations in the action of these insecticides have a great significance on the plant protection work against insect pests. Therefore, it was considered desirable to undertake a systematic investigation to ascertain the causes for these differences and to find out the effect of different variables. In this preliminary report we give the results which have been obtained with cockroaches (*Periplaneta americana*) grown under laboratory conditions when tested with DDT under comparable conditions at different period of the year show lower mortality in summer months with the same dosage of the insecticide than that was obtained in winter months. It has also been noted that when DDT in appropriate amount is mixed with the cuticular wax of these insects it dissolves and thus causes a lowering of the melting point of the wax. This phenomenon must be one of the chief factors responsible in the mode of action of such insecticides in such cases. But it is not able to explain the difference in susceptibility with variation of seasons as mentioned above. A further examination of the nature of the wax obtained from cockroaches at different periods of the year have also shown that it differs materially both in physical and chemical composition according to the sex, age and period of the year. It is considered that the difference in the action of DDT must be due to such differences. Further work in this direction is in progress.

**281. A new method of estimation of unsaturated glyceride.**

G. C. DEY and A. N. SAHA, Calcutta.

A new method has been evolved on the basis of the solubility of the lead salts of maleic anhydride adducts of glycerides of unsaturated conjugated acids. The Pb salts of different glyceride adducts precipitates from alcoholic solution of the salts at different temperatures.

**282. Viscosity of a fraction of starches of cereals and pulses.**

R. D. PATEL, and R. S. PATEL, Anand.

The viscosities of aqueous solution of A-fraction of different cereal and pulse starches are measured at 30°C and the result are considered from the point of view of Huggin's and Simha's equations, usually applied to the system of larger molecules. It is observed that pulse starches have higher intrinsic viscosity than those of cereal starches. The nature of plots of  $\frac{\eta_{sp}}{C}$  against C of cereal and pulse starches is straight line and when they are extrapolated they meet at a point to the left of the origin.

**283. Chromatographic Studies on the Composition of Caramel.**

N. A. RAMAIAH, S. K. D. AGARWAL, and J. K. P. AGARWAL, Kanpur.

Chromatographic studies on the composition of caramel produced by heating sugars in solid state were made using Whatman filter paper No. 1 and butanol-ethanol-water mixture as solvent. Reducing compounds of the following Rf ( $\times 100$ ) values could be detected: 1.9, 4.4, 6.4, 8.9, 16.3, 19.6 and 38.8. The Chromatograms indicated the absence of any acid in the caramel. The data further showed that whatever may be sugar employed initially for the preparation, the

composition of caramel was the same indicating that a transformation similar to that contemplated by Van Ekenstein (Rev. Trav. Chim. 14, 156, 1895) leading to the production of equilibrium mixture of glucose, fructose, and maltose, which apparently formed the basic material for the production of caramel.

**284. Prevention of Acetoacetate induced Diabetes by the condensation product of Glucose and Acetoacetate and its sparing effect on blood GSH.**

M. C. NATH and R. M. BEHKI, Nagpur.

The effect of the sodium salt of the condensation product of glucose and acetoacetate or glucose-cyclo-acetoacetate on the acetoacetate induced hyperglycemia and blood GSH depletion has been studied. The rabbits maintained normal levels of blood GSH and blood sugar when an equimolar amount of the Na salt of condensation product was administered 3 minutes before the single as well as repeated daily injections of acetoacetate for 41 days. 1:2 dienol glucose which can be liberated from glucose-cyclo-acetoacetate, on acid hydrolysis, has been found to react with dehydroascorbic acid and to reduce it back to ascorbic acid. The mechanism by which glucose-cyclo-acetoacetate shows its sparing action on blood GSH in vivo has been discussed.

**285. Occurrence of Glucose in combination with Acetoacetate in normal blood.**

M. C. NATH, R. M. BEHKI and V. K. SAHU, Nagpur.

Normal blood from men, rats and rabbits has been found to contain a compound which on hydrolysis gives rise to a reducing sugar and acetoacetate as evidenced from the liberation of acetone. The molar ratio of the reducing sugar to acetoacetate is not constant either in the hydrolysed blood or in the hydrolysed pure sample of the condensation product prepared in the Laboratory, perhaps on account of the loss of the dienol acetoacetate liberated and owing to its further polymerization. The constituent of the blood giving an orange-red colour with  $\text{FeCl}_3$  (10% solution) has been identified as the condensation product of glucose and acetoacetate by the circular paper chromatographic technique. The  $R_f$  value of the condensation product in such chromatogram has been found to be .64. A clue regarding the source of 1:2 dienol glucose in normal blood has been found out. The in vivo combination of glucose with acetoacetate has been confirmed.

**286. The mucilaginous principle in Blackgram (*Phaseolus radiatus*, L.).**

H. S. R. DESIKACHAR and M. SRINIVASAN, Mysore.

Blackgram flour gives a sticky dough with extensible properties like wheat flour dough. It was first thought that the adhesive property might reside in the pulse protein, because a similar property is possessed by wheat gluten. However, by fractionating the blackgram flour and studying the property of each fraction, the adhesive character was associable with a mucilage of a polysaccharide type.

The methods of extraction of this mucilaginous polysaccharide from the blackgram flour and subsequent fractionation by stepwise precipitation to obtain it in as pure a form as possible free from accompanying protein and some of its properties are described. The final polysaccharide fraction, still having 2% N was found, after acid hydrolysis, to be composed of the following chromatographically detectable sugars: arabinose, galactose, rhamnose and uronic acids.



## INDUSTRIAL CHEMISTRY

## 287. Aconitic acid content of Indian Molasses.

S. MUKHERJEE and SURISH CHANDRA, Kanpur.

Molasses samples from eighteen sugar factories situated in different parts of India were analysed for their total aconitic acid content. The molasses solution was first diluted five times and the pH of *m* was adjusted to 6.5 and boiled. A saturated solution of lead acetate was then added with stirring. The precipitated lead aconitate was filtered and aconitic acid content of the precipitated lead aconitate was estimated by decarboxylation according to the method of Roberts and Ambler.

It was shown that the percentage of aconitic acid present in Indian molasses is more than that reported for molasses from West Indies and Queensland but less than those reported from Egypt or Louisiana. There does not appear to be any obvious relationship between aconitic acid content of the samples, the district from which they originated or the variety of cane crushed. The aconitic acid content varies from 2.1 to 4.2% on 100 Bx.

## 288. Recovery of sugar and edible syrup from Molasses.

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

The waste molasses contains about 30% of sucrose, 20% of reducing sugars and 50% of organic and inorganic nonsugars. The final purity of the molasses depends upon the extent to which these non-sugars are removed.

Molasses (500 gms.) of purity 40.1% was diluted and limed and then subjected to double carbonation and single sulphitation process. This was then concentrated to 75°–80° Brix when an appreciable amount of salts crystallised out. After separation of the salts by centrifugation, it was diluted and passed through columns of action and anion exchange resins and concentrated to 80° Brix when most of the sucrose crystallised out. This was separated by centrifugation and the mother liquor served as the edible syrup.

Yield of sucrose	140 gms.
Yield of edible syrup	75 c.c./80 Bx.

## 289. Jeol Gum as flocculating agent in Cane Juice clarification.

A. K. CHATTERJEE and S. MUKHERJEE, Kanpur.

Studies on the structure of plant gums and mucilages show that these can be looked upon as naturally occurring high polymer having repeating units of glucuronic and galacturonic acids, which dissociate in water solution to give negatively charged particles with large numbers of active centres.

Experiments have been carried out on a factory scale using Jeol gum as a flocculating agent in the clarification of cane juice. It has been found that Jeol gum in 6 P.P.M. works equally good as Lytron x-886 (a foreign product specially used for the purpose). It was found that the use of the gum gave faster settling rate, brighter and clearer juice and compact mud.



**290. "Insecticide from Solvent Naphtha".**

**E. D. DARUVAL, M. H. DESAI and PRIT PAL SINGH, Delhi.**

In the present work, a successful attempt has been made to utilise the chlorine which is the by-product of caustic soda manufacture and also the solvent naphtha obtained in coaltar distillation. Solvent Naphtha was fractionally distilled and the fraction between 120-130°C only was chlorinated. The chlorination was carried out at 20°C to 25°C and for five hours in presence of 2 per cent reduced iron.

Before passing the chlorine gas in the solvent Naphtha fraction it was freed from moisture by passing through concentrated sulphuric acid, and then through an empty tower so that the sulphuric acid may not be carried into the solvent Naphtha fraction along with chlorine and thus discolorising and reducing the yield of the product.

The chlorinated product contained 57.6% mono-chloro and 42.4% poly-chloro (di & tri-chloro) derivative. The details of the work will be published elsewhere.

**291. Changes induced in low temperature Tar on storage.**

**MOHAMED EHSAN, B. S. NARAYAN RAO and M. G. KRISHNA, Hyderabad-Dn.**

A comparative study was made of the effect of storage under air and carbon di-oxide on the properties of low temperature tar. Samples of heavy tar obtained from the 25 ton/day Lurgi-Spuelgas L.T.C. plant were collected and stored under air and CO<sub>2</sub> separately for over 7 months. Analysis of the stored samples indicate that in both the cases toluene-insoluble matter increases from 1.0% in fresh tar to 1.41% in sample stored for 7 months. The specific gravity, moisture content and yield of fractions upto 230°C remain essentially constant and tar acid content of the fraction 0-360°C increases by 2.3% over the period of storage. In the case of tar stored under air the residue above 360°C decrease by 6.7% while fractions between 300°-360° increase by 10-12%. In the sample stored under CO<sub>2</sub> there is negligible variation during the first 40 days of storage but after 7 months storage the residue above 360°C decreased gradually by 4% and fractions between 300°-360° increased by 4.5%.

**292. Laboratory studies on Alkali extraction of Tar Acids from low temperature carbonisation Tar Oils of Hyderabad coals.**

**Y. V. SUBBARAO, B. S. NARAYAN RAO, M. C. KRISHNA  
and S. HUSSAIN ZAHHER, Hyderabad-Dn.**

Laboratory studies were carried out on the extraction of tar acids from 'Light tar' fraction produced in the Lurgi Spuelgas Low temperature Carbonisation pilot plant using a mixer-settler type batch extraction unit. Using equal volumes of 10% sodium hydroxide and light tar, the effect of mixing time on the extent of extraction was studied. It was found that starting with tar containing 31.2% wet crude tar acids, 99.4% of the acids can be extracted with 15 minutes of mixing time.

Optimum conditions for subsequent liberation of tar acids from phenolate solution with CO<sub>2</sub> were determined using an externally heated column. A temperature of 98-100°C was found to be necessary for efficient and almost complete separation of tar acids.

**293. Studies on Air-blowing of Low Temperature Coal Tar—Part I.**

B. S. NARAYANA RAO, R. VAIDYESWARAN, ANANTH N. DHARMAPURI, MOHAMMED EHSAN, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad.

Tests on blowing air through 'Heavy Tar' produced in the Lurgi Spuegas pilot low temperature coal carbonisation plant installed in the Regional Research Laboratory, Hyderabad are described. The effects of temperature, rate of air-blowing and the total quantity of air blown on the yield and softening point of the residue are indicated. It is found that with increasing temperature and total air blown, the softening point of the residue increases while the yield decreases. At the same temperature for the same total air, the softening point increases with increase in air-rate up to one cu. ft./hr. lb. of tar and then decreases with further increase in air-rate. The yield of pitch continuously decreases with increase in air-rate.

**294. Studies on Air-blowing of Low Temperature Coal Tar—Part II.**

B. S. NARAYANA RAO, R. VAIDYESWARAN, ANANTH N. DHARMAPURI, MOHAMMED EHSAN, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad.

Tests on blowing nitrogen and carbon dioxide through 'Heavy Tar' produced in the Lurgi Spuegas pilot low temperature coal carbonisation plant are described and the results compared with similar results obtained with air-blowing. It is found that at the same temperature, same rate of gas flow and for the same quantity of gas blown, the effect of nitrogen and carbon dioxide is far less pronounced than that of air with regard to the yield and softening point of the residue. While air-blowing gives a residue of medium hard pitch (74°C R & B), carbondioxide or nitrogen gives a soft pitch (44°C R & B). The yield of pitch is also reduced with air. There is little difference between nitrogen- and carbon-dioxide-blowing. Air-blowing leads to the formation of water (3%) while carbon-dioxide or nitrogen gives less than 1% water. The water formed with air-blowing may be due to the dehydrogenation of the tar while the increase in softening point may be due to the subsequent polymerisation and condensation.

**295. "Study on Fischer-Tropsch Synthesis"—Part VII.**

G. C. BASAK, N. C. NIYOGI and B. CHAKRABARTI, Howrah.

Work on Fischer-Tropsch synthesis was further studied with coal-gas by varying its composition with respect to CO and H<sub>2</sub> contents. Previous work in this line showed that cobalt catalyst was comparatively more active in the hydrogenation of CO of coal gas than the iron catalyst.

Experiments were conducted by using a cobalt catalyst of composition 40 Co : 5 ThO<sub>2</sub> : 10 MgO : 80 kieselguhr (bulk-density 0.36 Kg./litre) after its reduction with H<sub>2</sub> at 400°C. The composition of coal-gas was varied by incorporating regulated amounts of CO and H<sub>2</sub> from outside. The compositions were varied so that CO:H<sub>2</sub> ratios in the mixed gases were roughly 1:3, 1:2, 1:1.5 and 1:1, with a view to studying the course of reaction which would lead to the maximum production of liquifiable hydrocarbons, keeping other variable factors like temperature, space-velocity etc. constant.

The results of experiments showed that the percentage contraction decreased from a maximum of 19.3% to 10.6% with the corresponding increase of CO:H<sub>2</sub> ratio from 1:3 to 1:1. The percentage liquifiable products showed gradual decrease from 71.6% to 12.5% with the increased ratios of CO:H<sub>2</sub> from 1:3 to 1:1. It

was striking, however, that little or no methane was formed with inlet gas mixture with high percentage of methane but it showed gradual increase as the partial pressure of methane decreased. With regard to the formation of hydrocarbons, it was observed that the maximum yield (35.6 gms/C. M) was obtained with original coal-gas having CO:H<sub>2</sub> ratio 1:3, which decreased to (23 gms/C. M) as the ratio reached 1:2, showing little change (29 gms/C. M) upto 1:1.5, but then a sudden decrease (7.3 gms/C. M) started as soon as the ratio went down to 1:1.

#### 296. Carbonization of Indian Woods.

S. P. MUKHERJEE and S. K. NANDI, Kharagpur.

Some common Indian woods were carbonized with a view to find out the yields and properties of the products obtained under different conditions. Such data about Indian woods are lacking, although similar data on foreign woods are available in literature.

Cocoanut shell and Sal wood (*Shorea robusta*) were carbonized at 3 different temperatures, ranging from 350 to 700°C. Results given below show the range of variation obtained by decreasing the carbonization temperature.:

Cocoanut Shell:—

Carbon: % yield 28.3 to 32.9, apparent density 0.64 to 0.5%, iodine adsorption (mg. per g. carbon) 270 to 211, methylene blue adsorption 5.1 to 3.9, ash % 1.8 to 1.2. Yield of liquor 46 to 45.4%, yield of gas (litres N.T.P.) 16.2 to 9.5%.

Sal Wood:—

Carbon: % yield 31.4 to 38.4, apparent density 0.51 to 0.48, iodine adsorption 207 to 164, methylene blue adsorption 4 to 3.8, ash % 4.9 to 2.8. Yield of liquor 42.8 to 41.5%, yield of gas 16.6 to 11.9%.

A.S.T.M. distillation of pyroligneous liquor showed that the percentage of tar increased with temperature of carbonization. The gas was combustible.

#### 297. Production on Low Ash Char from South Arcot Lignite.

P. S. MENI and V. KANNAN, Nagpur.

The South Arcot lignite is known to contain a waxy constituent which is a very valuable source of raw material badly needed for the boot polish industry. It is also reported that activated chars can be produced from it.

The present work was taken up with a view to producing low ash char from lignite, concurrently with the recovery of wax and tarry constituents of lignite.

It is observed that while approximately 2N HCl causes a good reduction in ash content of raw and dewaxed lignites, it does not effectively reduce the ash content of the chars.

However, if the lignite and dewaxed lignites (2.6% wax removed by benzene) are first washed with 1.99 N HCl and subsequently carbonised the reduction in ash content is remarkable, the higher the temperature of carbonisation, the better the char obtained. It has been possible to get a char with 1.97% ash at 800°C by this process.

#### 298. Fullers earths of Rajasthan—their occurrence and Bleaching properties.

S. S. JOSHI and S. A. SALETORE, Hyderabad-Dn.

Rajasthan possesses fuller's earth to the extent of 200-210 million tons distributed in two deposits at Kapardi in Barmer district and at Mudh in Bikaner. Samples of same were chemically analysed and also examined for grit and other impurities and found to be fairly free from same. They were then activated by

means of hydrochloric acid and sulphuric acid by usual methods and the products thus obtained tested for bleaching efficiency. The activated earths were found to compare well with market samples when used for bleaching groundnut oil. Their oil retention and other properties were also satisfactory.

### 299. Studies on the mineralogy of some Indian Ceramic Clays.

AMAL K. BHATTACHARYA, (MISS) KAMALA ZUTSHI and  
ABANI K. BHATTACHARYA, Agra.

Quantitative chemical analysis of four typical Indian ceramic clays has been performed. The ceramic clays—Rajmahal, Kasimbazar, Katni and Chitrakoot (obtained from the Govt. Pottery Works, Khurja, U.P.) have been suggested to be mainly composed of mixtures of Kaolinite and other types of more complicated structures containing Calcium, Magnesium, Sodium and Potassium, from a study of their  $\text{SiO}_2/\text{R}_2\text{O}_3$  ratio, Cation exchange capacity, Conductivity, Swelling and Shrinkage properties.

A study of the  $\text{SiO}_2/\text{R}_2\text{O}_3$  ratio of the clays gave some indication of the degree of weathering and hydration of the parent clay minerals, their degree of reactivity etc. Since cation exchange capacity is due to the broken bonds around the edges of the silica-alumina units or due to substitutions within the lattice structure of trivalent Aluminium or quadrivalent silicon and by the replacement of the hydrogen of the exposed OH groups by a cation, it has been suggested on the basis of the cation exchange capacities that Rajmahal and Katni clays have similar silica-alumina units. On the same basis Kasimbazar and Chitrakoot clays can be visualised to be composed of identical silica-alumina units.

It has been observed that Chitrakoot and Rajmahal clay suspensions are much more conducting than Kasimbazar and Katni clays. Conductivity may be taken to give a measure of the soluble salts formed by the decomposition of clay minerals, or in other words, conductivity indicates the reactivity of the clay minerals present in the system. It is very interesting to observe that the swelling and shrinkage of these clays are in the same order as their conductivities. It therefore follows that the swelling and shrinkage are intimately connected with the quantities of the soluble salts.

### 300. Studies on Particle Size Distribution in Hyderabad Clays—Part I.

M. A. QAIYUM and ABDE ALI, Hyderabad-Dn.

Particle size distribution in two residual clays of Hyderabad, Kamthana and Srirangapur, were studied by sieve analysis as well as by gravitational sedimentation methods, employing Andreasen-Bürner Pipette. The results of the mechanical analyses indicated that the Kamthana clay contained 15.75% undecomposed rock and sand coarser than 300 mesh (B.S.S.)- $53\mu$ , 20.5% particles of  $53-30\mu$ , 2% of  $2-0.5\mu$  and more than 60% particles finer than  $0.5\mu$ . Srirangapur clay consisted of about 50% particles coarser than 300 mesh-- $53\mu$ ; 17.5% of  $2-0.5\mu$  and about 40% finer than  $0.5$ . Further investigations on the above clays are in progress.

### 301. An Apparatus for Differential Thermal Analysis and its Calibration.

ABDE ALI and A. V. RAJESWARA RAO, Hyderabad-Dn.

A Differential Thermal Analysis apparatus which is fully automatic, and precise has been installed. The heating schedule of the horizontal tube furnace is controlled by using electronic control unit and potentiometric controlling recorder

and motor operated variable transformer. The rate of heating of the furnace and the sample is quite linear ( $12.5^{\circ}\text{C./min.}$ ) and exactly reproducible. The sample holders are of ceramic type (Roberts and Grimshaw pattern). The thermocouples are of Pt.-10% Rh. and Pt. The differential e.m.f. and sample temperature is recorded by means of X-Y recorder, which consists of two balancing systems enabling one variable to be represented on the horizontal axis and the other on vertical axis, giving continuous curves of differential e.m.f. (X-axis) against sample temperature (Y-axis). A pre-amplifier is used to amplify the differential e.m.f. and the sensitivity of the recording system can be varied according to the requirement. The recorders were tested by giving fixed input. The differential and sample temperature thermocouple is calibrated by making use of the sharp peak shown by quartz at  $573^{\circ}\text{C.}$  in its thermal curve due to its transformation from  $\gamma$  to  $\beta$  form. Samples of Kaolinites from Drybranch, (U.S.A.), Cornwall (U.K.), Gordon (Australia) and Travancore run on this apparatus gave excellent and reproducible results. A peak of 5 cm. in length was obtained for a pure quartz from Hyderabad.

### 302. Study of Hyderabad Clays by Differential Thermal Analysis Method-- Part I.

A. V. RAJESWARA RAO and ABDE ALI, Hyderabad Dn.

Preliminary studies of the principal Hyderabad clays, in their raw and washed forms, were made by Differential Thermal Analysis (D.T.A.) method on an automatic and precise apparatus. The D.T.A. curves during cooling and reheating upto  $700^{\circ}\text{C.}$  were also recorded to find the presence of quartz in the clays. Kamthana Clay indicated mainly the presence of Kaolinite and the presence of quartz was not noticeable. It is not so well crystallised as Travancore clay which was indicated by the decreased intensity of exothermic peak, taking place at a lower temperature. The D.T.A. curves of Sekhapur clay were similar to that of Kamthana clay with decreased intensity of thermal reactions. It indicated the presence of small amount of magnesite (endothermic peak at  $745^{\circ}\text{C.}$ ). The Pachagaon clay showed that it is a poorly crystallised kaolinitic fire clay type with good quantity of quartz ( $<20\%$ ) present. The D.T.A. data for Srirangapur showed three well defined endothermic peaks at  $150^{\circ}$ ,  $705^{\circ}$  and  $885^{\circ}\text{C.}$  corresponding to Montmorillonite and a small endothermic peak indicating the presence of Kaolinite. The D.T.A. observations of Chintrayal clay indicated the presence of large amount of quartz ( $<30\%$ ) and complete absence of Kaolinite.

### 303. Residual Acidity in Acid-activated Bleaching Clays.

MANIK LAL SEN GUPTA, Calcutta.

Acid activated bleaching clays are usually associated with a certain degree of residual acidity. Part of this acid is free and extractable with water and the other part is only liberated by base exchange in presence of salt solutions. The former is an index of the extent of ashing applied in processing and can be utilised in identifying the activating acid; the latter gives a measure of the base exchange capacity of the clay, although cations in wash water have already occupied some of the exchange positions. Commercial activated adsorbents contain only small quantities of residual acidity varying from 2-6 c.c. 0.01 N NaOH per gm. But even this amount can cause very marked changes in the properties of the bleached oil such as acid and peroxide values as well as ultraviolet absorption spectra. The effect of such changes however has to be considered in relation to the ultimate application of the oil.

**304. A Study of the effect of Grinding and Storing in Water on the Hydraulic Property of a Slag.**

K. RAY, S. CHATTERJEE and D. LAHIRI, Calcutta.

Portland blast furnace cement is manufactured by grinding Portland cement clinker and granulated blast furnace slag with about 5% gypsum. The slag is usually granulated by chilling in water. The granulated slag is dried before grinding with Portland cement clinker. Since drying involves cost and wet grinding is more efficient than dry grinding, this investigation was conducted to know if granulated slag as obtained from one major Iron and Steel works of India could be wet ground and preserved without impairing its hydraulicity. It was found, that wet grinding of slag alone did not impair its hydraulic property. The hydraulic property improved with time of storage in water. When slag was ground with gypsum the hydraulicity of the slag was found to deteriorate with time.

**305. Measurement of "Aftertack" in Drying Oil Films.**

D. M. DESHPANDE and K. K. DOLLE, Poona.

Drying oils constitute an important component of surface coating materials. Some of the drying oils, however, exhibit "aftertack", a very serious drawback since these oils do not dry to hard films. This "aftertack" is recorded only qualitatively in literature. In the present paper, a newly designed instrument is described for the quantitative measurement of this defect of drying oils by determining the force required to pull out a hard rubber ring from the surface of the tacky film.

**306. Measurement of "Water Resistance" of Drying Oil Films.**

D. M. DESHPANDE and K. K. DOLLE, Poona.

Drying oils are found to impart the property of water proofing to the films formed from them. In this paper, an instrument is described which gives a quantitative measure of the "water resistance" of oil and varnish films. When such films are subjected to the action of water, they become white and ultimately may become opaque to the naked eye. In other words, the percentage transmission of light through the film goes on diminishing gradually. The instrument is designed to measure this part of transmitted light by a photo-electric cell.

It is possible by using this instrument to have a quantitative and hence a graphical representation for the "water resistance" of drying oil films.

**307. Catalytic Polymerization of Oils.**

H. C. ZAIDI and L. Y. WADAKAR, Hyderabad-Dn.

Aluminium chloride is an effective catalyst for the polymerization of safflower oil even at concentrations as low as 1%.

The amount of polymer formed increases with the catalyst concentration, temperature and time.

A gel is formed at 300°C. with a catalyst concentration as low as 0.2% in ten hours and 5% within one hour only.

The products are viscous liquids and gels of slightly dark colour.

**308. Catalytic Isomerisation of Drying Oils in the presence of Polymerisation Retarders.**

B. S. KULKARNI, Hyderabad-Dn.

Systematic studies in the catalytic isomerization of polyunsaturated fats with basic, acidic and neutral catalysts have not so far been reported. Isomerization carried out at higher temperatures is interfered with by heat bodying and polymerization effects. In the present investigation preliminary results on the catalytic activity of the basic catalyst, viz. CaO in the isomerization of safflower oil in presence of 1% of hydroquinone as polymerization retardant have been reported. The CaO has been found comparatively a very weak isomerization catalyst.

**309. Diene formation in the field of natural and artificial drying oils and changes in diene values of unsaturated oils during heat bodying at different temperatures.**S. M. DAS GUPTA, HARI SINGH, P. C. JUNIJA and  
A. C. MUKHERJI, Delhi.

During recent years, the diene reactions of drying oils are receiving increased attention on account of the fact that by such mechanisms the drying oils not only self polymerise but copolymerise with other diene hydrocarbons. In this paper, the diene values of some commercial drying oils (natural and artificially made) have been determined both at ordinary and elevated temperatures. It has been found that safflower oil, which is receiving wide acceptance because of its colour retention, uniformity of gel structure and uses in the manufacture of alkyds, contains some small amount of conjugated fatty acids. This is at present considered to be non-conjugated. Further, although naturally occurring conjugated tung oil gives almost the theoretical maleic anhydride number, the artificially made conjugated oils give low figures. The type of conjugation in these latter oils either exist in the pseudo-form or offers some steric hindrance to Diels-Alder type of reaction. At elevated temperatures, the diene values rapidly increase within an hour but then diminish. Further work is being done on the effect of driers in diene formation.

**310. Preparation of safflower modified alkyds by the alcoholysis process using litharge as the catalyst.**

N. BHOJRAJ NAIDU and S. A. SALTORI, Hyderabad-Dn.

Since Hyderabad produces annually about 1.25 lakh tons of safflower seed, the present work was taken up to investigate the possibilities of utilisation of safflower oil in the production of copolymerised alkyds. Glycerol safflower oil resins of 40% oil length were prepared, at different cooking periods, their kinetics of reaction studied and the results reported. A resin of low acid value 12.6, was obtained and it was found compatible with xylene-toluene mixtures and acetone. A 50% resin solution in xylene gave a viscosity of 8.25 poises. The Lovibond colour of same seen through a 1 c. cell was 2.4Y, 0.7R. Its film-making properties were evaluated.

**311. Rectification of Palmarosa Oil of low geraniol content.**

L. M. SRIVASTAVA and S. H. ZAHNER, Hyderabad-Dn.

India holds an important position with regard to the production of palmarosa oil which is the main source of high quality geraniol employed in all important formulations in perfumery and the soap industry. From the commercial point of

view the most important regions in which the oil is produced are Madhya Pradesh, Bombay and Hyderabad Deccan.

Hyderabad produces the bulk of the oil exported but the oil has a low geraniol content of about 60-70%. The process of rectification by steam distillation is a lengthy one and the separated terpenes contain about 40% geraniol. Attempts to rectify by complete vacuum distillation were not successful due to production of polymerised residues (about 6%) and spoilage of odour. However, by distilling only the terpene fraction in vacuum oil of 90% geraniol content is produced without affecting the odour. The process developed has been tried on a laboratory and pilot plant scale with various grades of palmarosa oil and found to yield good product of 90% geraniol content suitable for export.

### 312. Recovery of Hard Wax from Sisal leaves.

V. R. AMBEKAR and K. K. DOLE, Poona.

Sisal leaves are obtained from sisal plant and are used as a valuable source of fibre. The surface of the leaf is covered with a white waxy layer. The wax from the two varieties of sisal leaves—agave cantala, and agave veracruz—has been extracted by different solvents such as, trichlorethylene, benzosol, n-hexane, and toluene and the yield of the wax has been found on the basis of green leaves as they are cut from the plant. The wax has a light green colour and high melting point. The further work in analysis of the wax is being carried out.

### 313. Rice-bran Oil.

V. R. AMBEKAR and K. K. DOLE, Poona.

Rice-bran is a by-product of rice milling industry and potential source for edible oil and wax. Rice-bran on keeping becomes rancid due to the extremely active lipolytic action. This enzyme reaction is checked to a greater extent by heating the bran at 105°C. for 2 hours, thus facilitating storage or hauling to proper site for extraction purposes. Different solvents are used for extraction of oil and wax. It is found that n-hexane and benzosol give better yield as compared to other solvents, used in experimental work. Percentage of oil and wax has been determined in a rice-bran obtained from different strains of rice grown all over the Bombay State at different experimental stations of rice farms. It is found that strains such as Ambemohor (No. 102, 159 & 157) Kamod-118, Pankhri 203, give better yield of oil and wax as compared to other strains. The oils from Ambemohor strains have very good flavour. Some of the strains yield low percentage of oil and wax. The wax has a light brown colour and useful as a substitute for imported waxes like wax carnuba.

### 314. The component acids of the Indian wild Boar (Male, depot) Fat.

S. P. PATHAK and B. N. TRIVEDI, Banaras.

The fat of wild Boar (male, depot) was obtained from the Ghisaoli forest situated between Jhansi and Lalitpur, two miles from Batava river. Solvent crystallisation and ester fractionation methods have been utilised for the present study.

The component acids present are myristic 0.92%, palmitic 26.3% and stearic 15.45% and myristoleic 0.01%, Palmitoleic 14.8% and oleic 42.24%. The mean unsaturation of the unsaturated acids are -2.0, -2.0, and -2.1 respectively.

The animal wild Boar is mainly carnivorous unlike the Hog or the pig and therefore the composition of the present fat should be compared with the carn-



vorous animals like tiger, lion, etc. The percentage of the total saturated acid is 45.49% in Tiger, 54% in lion and so on with palmitic and stearic acids predominating, and the unsaturated acid being oleic about 40%. Linoleic or linolenic acid is practically absent. Comparing the present fat with the above ones, it is clear that it aligns itself with these than with Pig or Hog fat which is herbivorous and contain di and tri-ethylenic acids.

**315. The component acids of the Indian Bear (Female, depot) Fat.**

S. P. PATHAK and B. N. TRIVEDI, Banaras.

The sample fat was obtained from the Chherpunda situated in the north east corner of district Ambikapur (M.P.). The usual saponification, lead salt-alcohol separation and finally methyl ester fractionation of the separated fractions into sub-fractions have been used for the present study.

The chief component acids present are myristic 1.83%, palmitic 24.96% and stearic 10.67% amongst the saturated and amongst unsaturated  $C_{14}$ ,  $C_{16}$ ,  $C_{18}$  are present to the range of 1.25, 18.0 and 43.16% with the mean unsaturation—2.0, —2.0 and —2.4 respectively.

Comparing the above data with the reported Ceylon Bear fat and sacred Baboon depot fat in which stearic acid content is from 2.8% the present fat of the Indian Bear shows variation in which the stearic acid content is 10.67% of the total mixed acids. It is thus evident that the general rule of 'even distribution' which governs the composition of vegetable fats are operative in the two reported animal fats namely Ceylon Bear and sacred Baboon fat, in which the stearic acid is only a minor component has no analogy with the Indian Bear fat studied by the authors.

**316. Spectrophotometry in Leather Research—Part VIII : Investigation of chrome complexes with inorganic acids and salts.**

D. RAMASWAMY and Y. NAYUDAMMA, Madras.

A u-v. spectrophotometric method was applied to the study of the complex nature of basic chromium sulphate solution containing weaker inorganic acids and their salts. Indications have been obtained for possible complex formations with thiocyanate, silicate and fluoride ions. The practical applications of these results in the leather field are discussed.

**317. Spectrophotometric studies in Leather Research.—Part IX. Studies on the Ultra-violet Absorption Spectra of Purified Tanning Materials and their Derivatives.**

Y. NAYUDAMMA, (Miss) A. NAGASIROMANI, D. RAMASWAMY and K. S. SHASTRY, Madras.

The phenolic groups of the tanning materials possess intense absorption in the u-v region. It has already been shown that from their absorption characteristics, the different phenolic groups and acids contained could be determined. An extension of these studies were made with a few solvent purified tanning materials and their derivatives by employing ordinary as well as the differential method. The tanning materials when methylated and acetylated have been found to cause a shift in the maximum absorbance and change in its intensity and their significance pointed out. The difficulty of ionisation of methyl and acetyl derivatives on addition of alkali has been taken advantage of to predict whether the phenol group is completely replaced or not.

**318. Yellow discolourisation of Curing Salt in presence of Sodium Silico Fluoride.**

S. C. NANDY, S. N. SEN and B. M. DAS, Madras.

The admixture of sodium silicofluoride to curing salt as a direct bactericide for efficient curing and preservation of hides and skins is found to be of mixed success. In an experiment with Sodium silico-fluoride we strikingly observed that the surface of the experimental hide pieces that were cured with common salt and sodium silicofluoride developed yellow colour after some days. It was found due not to any bacterial growth but to something which was suggestive of chemical reactions. Subsequently it was also observed that the common salt itself turns yellowish when sodium silicofluoride was mixed with it. Evidences so far obtained are suggestive of the following mechanisms. Sodium silico fluoride liberates hydrogen fluoride in presence of moisture and this in presence of ferrous and ferric salts, that may be contained in common salt, forms a complex compound, probably of the composition ferrous mono ferri fluoride,  $\text{FeF}_2$ ,  $\text{FeF}_3$ ,  $7\text{H}_2\text{O}$  which has a distinct yellow colour.

**319. On Limiting Dephosphorisation of Alloys in Hydrogen.**

B. CHATTERJEE and R. K. MITRA, Sibpur.

In continuation of our studies on the dephosphorisation of alloys under gaseous anneal, studies have been made of the removal or otherwise of phosphorus from powdered samples ( $< 40$  mesh) prepared from two specimens of cast iron, I (P, 1.3%) and II (P, 0.9%), on heating at  $1000^\circ\text{C}$  for varying periods of time in flowing hydrogen containing 1.2 per cent by volume of moisture. It has been observed that the phosphorus content of sample I comes down to 0.9 per cent in 25 hours under the conditions of the experiments and that practically no dephosphorisation takes place on further treatment in moist hydrogen. It was also observed that the phosphorus content of sample II suffered no loss under these conditions. The results presented in this paper is of interest in that they suggest that moist hydrogen can bring about dephosphorisation at  $1000^\circ\text{C}$  only in samples, the phosphorous contents of which are above 0.9 per cent. Further work on this issue especially in relation to the composition of the alloys is in progress.

**320. Further studies on the production of Hydrogen Sulphide from Calcium Sulphate.**

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Deccan.

Hydrogen sulphide is produced from calcium sulphate by passing steam over heated mixture of calcium sulphate and coke at  $800^\circ$ . The recovery of sulphur as  $\text{H}_2\text{S}$  is complete when the reactants are taken in the proportion of  $\text{CaSO}_4$  : coke :  $1:0.1$  by weight. The probable reaction steps are the reduction of calcium-sulphate by coke, followed by hydrolysis of the calcium sulphide formed, with steam. Keeping the rate of steam constant, the reaction proceeds at constant rate and the same amount of sulphate is decomposed irrespective of the concentration of the sulphate.

**321. Thermal Decomposition of Calcium Carbonate—Part II. Effect of Silica.**

ABDE ALI, Hyderabad-Deccan.

The reaction of Calcium Carbonate with Silica has been studied at different temperatures using different proportions of reactants, and the available lime in the product has been estimated by Iodine method. Most of the lime in the product was in available form at lower temperatures ( $740^\circ\text{C}$  to  $800^\circ\text{C}$ ) for all the

proportions of Calcium Carbonate and Silica studied. The non-available lime increased with temperature for all the proportions investigated. The unavailable lime was about  $\frac{1}{3}$ rd of the lime content in the reaction mixture when the temperature of the reaction was between 900°C to 1000°C. Formation of tri-calcium silicate was indicated between 900°C to 1000°C.

**322. Thermal Decomposition of Calcium Carbonate—Part III. Effect of Alumina.**

ABDE ALI, Hyderabad-Deccan.

The reaction of Calcium Carbonate and calcined Alumina has been studied at different temperatures using different proportions of reactants and the available lime in the product has been estimated by Iodine method. The unavailable lime increased with rise in temperature when the proportion of the reactants are kept constant. At a constant temperature the unavailable lime is more with higher proportion of alumina. Formation of tricalcium aluminate is indicated in which, on hydrolysis 2 out of 3 CaO molecules are in available form.

**323. Study of Formation of Urea Complexes of Technical Monoglycerides.**

T. N. MEHTA and S. N. SHAH, Nagpur.

Technical Monoglycerides have been fractionated with urea in methyl alcohol. Urea forms complexes more easily with diglycerides than with monoglycerides as shown by Bradley, Mueller and Shokal and contrary to the observation of Heckles and Dunlap. Further in stepwise crystallization of commercial monoglycerides there was no methanolysis of the monoglycerides as observed by Aylward and Wood.

**324. Cyclization during Heat Bodying of Safflower Oil at 300°C.**

T. N. MEHTA and S. N. SHAH, Nagpur.

Safflower oil was heat bodied at 300°C and its methyl esters were fractionated by vacuum distillation and with urea. The monomeric cyclic compound was isolated as the non-adduct forming distillate. It was presumably a cyclized product of methyl linoleate as it has a mean molecular weight of 293.7 (Theo. 295) and mean unsaturation of -1.96 to -2.01.

**325. "Industrial uses of Calcium Chloride".**

R. P. PURI, Dhrangadhra.

Calcium Chloride forms an important by-product in many manufacturing processes including Soda Ash, Potassium Chlorate and bitterns in salt industry. The indigenous manufacture of the chemical is only a fraction of the potential capacity of production because of limited use of the material. In view of the contemplated increase of soda ash manufacture in the second five year plan, the development of industrial utilization of this product merits a serious consideration. Important developments towards its utilization, as have taken place in other countries particularly in U. S. A., have been reviewed in the paper with a view to put it before the Indian Scientists and industrialists. The major uses mentioned therein are : as an admixture in cement concrete to accelerate setting etc., for laying low cost unpaved roads, as a dust allaying agent in coal and other mining industries and as a liquid ballast for tyre weighting etc. It has been shown that the production of Calcium Chloride may really fall short of the requirements, should the reviewed uses of the chemical are given an industrial shape in the years to come.

## SECTION OF GEOLOGY AND GEOGRAPHY

*President* :—DR. BHABESH CHANDRA ROY, A.I.S.M., M.Sc., D.I.C.  
(Lond.), Dr.Ing. (Freiburg)

### *Abstracts*

#### A. GEOLOGY

##### (i) General, Stratigraphic and Structural Geology.

##### 1. Anjar Earthquake of 21st July, 1956, Kutch.

M. S. BALASUNDARAM, and M. C. PODDAR, Calcutta.

On Saturday, the 21st July 1956 at 21 hrs. 3 minutes (IST) the whole of Kutch Peninsula was rocked by a severe earthquake, known as Anjar earthquake after the headquarter town of Anjar taluka which suffered the most damage. The damage due to this earthquake is confined to an area of approximately 750 sq. miles and was felt upto Lorwarda R.S. in the east, the western coast of Bhuj in the west, Hyderabad and Tharpakar districts of West Pakistan in the north and as far as Bombay in the south. According to the Kolaba observatory, Bombay, the epicentre was declared to be at 24 degrees north, and 70 degrees east, somewhere in the Great Rann. Majority of the local observers stated that the main shock lasted for a period ranging from a couple of seconds to a maximum of about a minute. Following the main shock there were at least 5 after-shocks within a week. They also stated that they heard noises like that of starting a diesel engine, galloping of horses on the roof, emptying of boulders from a loaded lorry or the approach of an aeroplane, preceding the main shock. The movement as described by them appeared to be firstly wavy and horizontal followed by vertical movements. According to official figures it is reported that about 115 people died, and 414 persons injured, out of which 64 were of a serious nature. Hundreds of houses collapsed either partly or completely in the following villages, Anjar, Tapar, Sukhpur, Jhuran, Ratnal, Kukma, Dhamadka, Bhimasar, Bhujpur, Jhikadi, Dudhai and Lodai. Heavy rainfall after the earthquake added to the damage of buildings already affected. It is noticed that kuchha houses with no proper bond or plaster have suffered most while pucca buildings escaped with minor damage. Apart from the damage caused to buildings and a few cracks on the ground surface, permanent railway lines, roads, bridges, culverts, were not affected by this earthquake. It is reported that the magnitude of intensity of the Anjar earthquake as worked out by Seismologists is about 7.

In the Kutch peninsula marine and non-marine sediments ranging from middle jurassic to recent times, and Deccan traps of cretaceous-eocene age are represented. The older sediments are folded and faulted, the latter striking almost east to west. The damaged localities seemed to be connected in some way with the comparatively softer foundation conditions and also the presence of fault planes in close proximity. From the available data, it may be surmised that any sudden re-adjustment along the faults mentioned above are likely to set up the vibration causing the earthquake.

Having known that the Kutch peninsula is in the seismic belt, it is advisable that any future construction in this area should have adequate safety factor against earthquake.

**2. A note on the Gneissic Rocks near Purulia, Manbhum District, Bihar.**

T. C. BAGCHI, Kharagpur.

Highly folded and sheared pelitic and psammopelitic rocks, comprising biotite schist, granite-gneiss and porphyroblastic gneiss, outcrop over a small area near Sahebund, Purulia. The biotite schist is feldspathised to varying degrees and contain isolated "pods" of porphyroblastic gneiss as inclusion. Although the alignment of feldspar porphyroblasts in all these rocks, particularly in the pelitic gneiss, is very similar to those formed by magmatic flow, microscopic study shows evidences of their formation in the solid medium. It appears that during regional folding and metamorphism of the sediments the rocks were permeated with feldspathising solutions through the already developed foliation planes. As the stress continued to act the feldspar matacrysts aligned themselves at right angles to the direction of tectonic stress giving rise to the flow structure.

**3. Conglomerate Deformation in the Western part of Singhbhum Shear Zone : Part I—Deformation Plan.**

ANIRUDDHA DE, Calcutta.

Deformed conglomerate horizons in the area between ( $22^{\circ}43'$ — $22^{\circ}48'N$  :  $85^{\circ}49'$ — $86^{\circ}E$ ) are repeated by isoclinal folds of large amplitude and small wave length transposed to recumbency in which axial plane schistosity and bedding are mostly coincident serving as planes of shearing and unrestricted movement, while the apical regions are mostly eroded out. Several horizons are identifiable, characterized by arkose, chloritic and argillaceous matrices. The pebbles and boulders are commonly of quartzite, while banded jasper, banded hematite jasper or quartzite, chert, and greenstone pebbles also occur. Concomitant with isoclinal recumbent folds open cross folds in  $a$  of smaller amplitude are formed (as at Bhurkuli hill, Dudhi, etc.). The deformation plan therefore involves converging movements during thrusting (Cloos, 1946). The crests of folds in  $b$ , when observable, show that the conglomerate has been flexurally folded together with the pebbles which have their long dimensions normal to fold axis; in the limbs the pebbles are parallel to the axial plane foliation ( $S_1$ ) and also bedding ( $S_1$ ) which are intensely compressed to parallelism, where no deviation of the elongation direction of the pebbles from schistosity plane has been found (cf. Oftedahl, 1948).

In the declining phase the deformation plan changed vectors, superimposing flexural folds with tectonic axis  $b_2$  oblique to  $b$  (as at Rudrapur, Dugni, north of Bandu, etc.), their later origin is evidenced by the fact that by unrolling these folds the direction of elongation of pebbles are restored to parallelism.

Microfabric orientation diagrams of quartz of deformed pebbles show  $bc$  girdle, around the direction of penetrative movement  $a$ , in which maxima III and VIII are very well developed.

**4. Conglomerate Deformation in the Western part of Singhbhum Shear Zone : Part II—Intensity of Deformation.**

ANIRUDDHA DE, Calcutta.

The conglomerates of the area are intensely deformed and contain pebbles elongated into ellipsoidal form, whose relative dimensions give estimate of the intensity of deformation undergone. All the dimensions of the pebbles, extracted carefully out of the matrix, have been measured and the intensities of deformation have been calculated for all the axes and expressed in terms of the radius of the

original spherical pebble of same volume. Average original radii of the pebbles vary between 2.2 to 4.8 c.m. From the deformation plan it is evident that the longest dimension  $a$  is proportional to the maximum deformation intensity. Commonly elongation in  $a$  is 200 to 350% of the original radius, while in certain zones parallel to thrust surfaces, intense deformation is evidenced by elongation to 450%  $r$ , beyond which the pebbles are thinned and detached rendering correct measurements impossible. Concomitant with elongation normal to fold axis  $b$ , there had been both elongation and shortening parallel to it. In the areas of cross folding the intermediate dimensions of the pebbles show a common shortening from 100 to 85%  $r$ , this may be a result of compression during converging thrust movement, while in zones where cross folding is absent intermediate dimension shows general extension averaging 120%  $r$  to as much as 180%  $r$ , evidencing stretching parallel fold axis  $b$ . The shortest dimension, normal to axial plane schistosity and/or bedding, shows extreme flattening commonly between 57% to 30%  $r$ , showing that there had been considerable reduction in stratigraphic thickness.

The effects of original deviation in shape from sphericity, protection of smaller pebbles from stress by larger ones, spatial heterogeneity of stress etc. has been discussed. The spatial variation of deformation intensity has been studied by drawing equal deformation lines following Cloos (1947).

##### 5. The Geology of the Area Around Dohad.

V. S. DUBEY and P. N. MEHTA, Banaras.

The area under review lies between Meghnagar—a station 20 miles to the north of Dohad—and Baroda on the Western Railway. The area to the north is very important because here the three orogenic belts, viz., Aravalli, Delhi and Bijawars meet. From the field study carried out, it appears that the manganese deposits of Jhabna (M.B.) are exactly similar to the manganese deposits of Shivrajpur-Pani mines and that it is a continuous belt made up of quartzites and phyllites in which manganese ore occurs interbedded. Here the Aravalli orogenic belt definitely takes a turn towards the NNW-SSE. The trend lines of the Delhi and the Bijawars are quite different in this area. The Delhi run in NE-SW direction while the Bijawars run in E-W direction, strongly suggesting that they belong to two different periods of orogeny. The first igneous acid activity belongs to the post-Aravalli period. The second acid igneous activity took place in the post-Delhi period and contemporaneous with the Erinpura granite, and the third belongs to the Bijawar period. The basic igneous activity took place in the Bijawar period and is post-Erinpura Granite.

This area represents a basin of sedimentation in the Aravalli period where the phyllites were being deposited interbedded at times with the manganese ores. It appears that the area of erosion which yielded these argillaceous sediments also gave rise to manganese-solutions periodically, which were deposited, interbedded with the phyllites. North of this area in the Aravalli region the manganese ores do not occur, suggesting that they came from the South.

##### 6. Trends of Sedimentation in Giridih Basin, Bihar.

C. NARASIMHA RAO, Kharagpur.

Giridih Basin consisting of the Lower gondwana sediments lies amidst gneisses near the town of Giridih, Hazaribagh district, Bihar. Lithological, petrological and stratigraphical relationships of the two chief stages have been presented in this paper. Modal analyses, size distributions and heavy mineral assemblages, were determined for the Talchir and Karharbari stages. Sphericity determinations were

made for typical rock types sampled across the strike. Grain size distributions were plotted and statistical size parameters calculated for the two stages.

The Talchir stage consists of basal boulder conglomerate, needle shales with interbedded sub-graywacke type of sandstones and coarse grits. The boulder bed shows distinct bedding, sometimes marked by alternating coarse and fine textures. The boulders are faceted and well rounded, but striated and grooved specimens indicative of glacial transport are rare. It appears therefore that the boulder bed may represent an end moraine sufficiently reworked by glacial streams and because of its distinctly bedded nature might be supposed to have been deposited in fairly deep glacial lakes. Alternating coarse and fine layers are perhaps due to fluctuating turbulent and stagnant condition of lake waters. The interbedded sub-graywackes and needle shales suggest conditions of unstable depositional site which underwent intermittent subsidence interrupted by comparatively calmer conditions ideal for needle shale deposition. The coarse grits overlying needle shales mark conditions of shallow water deposition possibly due to the gradual emergence of the lake basin which appears to have reached completion at the end of the Talchir period and the thin conglomerate on top Talchirs points out to the prevalence of subaerial conditions.

The Karharbari stage consists of principally greyish white arkoses with minor amounts of shale and coal seams arranged in more or less rhythmic fashion. The arkoses fall under the category of tectonic arkoses (Pettijohn 1949) and are cross bedded. Cross bedding is simple and similar to those that form in an advanced terrace constructed by a stream or a shallow water current. The convex lobes which indicate the current direction are towards east indicating a west-east drainage.

The environment in Karharbari stage was essentially that of rapid erosion and quick burial. The deposition of tectonic arkoses envisage a rising source area by upfaulting or uplift and a sinking depositional site by downfaulting. Directions of cross bedding suggest a rising source area towards west. Unfortunately the heavy mineral studies are far from helpful and do not give a true picture regarding the provenance of the source materials.

## 7. Geology around Vennur.

K. V. PESHWA, Poona.

The paper contains an account of the rocks occurring around Vennur (74° 49' : 15° 58') in Bailhongal taluq, Belgaum district. The formations occurring in the area are—

Detrital laterite soils, etc.

Deccan Trap lavas.

Lower Kaladgi quartzites and Sandstones.

Newer Dolerites.

Granite-gneiss and hornblende and chlorite schists etc. of Dharwar age.

The paper describes the rocks mentioned above and gives their mode of occurrence, lithology and mineral composition, and the heavy accessories in the Kaladgi rocks have also been studied.

## 8. The Age of the Dolerite Dykes of Mysore.

B. P. RADHAKRISHNA, Bangalore.

The largest number of basic dykes cutting across the different formations of Mysore have been hitherto assumed to be of Cuddapah age. The basis for such an assumption is questioned. The distribution of dykes in Mysore is shown to be



related more to plutonic centres and flexures in the crust rather than to volcanic episodes. In the Cuddapah area the innumerable basic dykes are seen to stop abruptly at contact with the Cuddapah rocks indicating thereby that the dykes are all pre-Cuddapah in age.

Since the dykes intrude the Closepet granites they must have formed after the emplacement of the Closepet granites and before the Cuddapah sedimentation and contemporaneous volcanic activity. This gives approximately the upper and lower age limits for the intrusion of the dykes. Evidence is lacking to ascribe a Cuddapah or post-Cuddapah age for the majority of the dolerite dykes of Mysore.

#### 9. A note on Granite Gneisses around Barkadih, Subdivision Gumla, Ranchi District, Bihar.

JOYSENJIT RAJKUMAR and SWADESH PRIYA SANYAL, Kharagpur.

An area of over 35 miles around Barkadih ( $23^{\circ}13'40''$  :  $84^{\circ}32'15''$ ), Ranchi district has been geologically mapped and studied. Special emphasis is laid on the petrology of the granite gneisses. Associated with granite gneiss are the porphyroblastic gneiss, basic rocks, calc-silicate rocks and permeation gneiss. The extreme heterogeneity in composition of the granite gneiss, gradual transition of pelitic country rocks to granite gneiss through intermediate stages of permeation gneiss and porphyroblastic gneiss, occurrence of relict feldspathised inclusion, all these indicate a probable metasomatic origin of the granite gneisses. Porphyroblastic gneiss is traversed by granite dykes containing isolated "pods" of porphyroblastic gneiss as inclusions. The foliation in these pods is perfectly parallel to the foliation of the adjacent porphyroblastic gneiss, indicating thereby that the granite dykes are perhaps of replacement origin.

#### 10. Indications of buried hills by Gravity and Magnetic Survey around Hijli, Midnapur District, West Bengal.

A. ROY, R. S. AGARWAL, S. K. CHOWDHURY, D. DAS, S. K. GUHA,  
N. N. BISWAS and S. DATTA GUPTA, Kharagpur.

An area of about 125 square miles around Hijli (Lat  $22^{\circ}15'$ — $22^{\circ}25'$  : Long  $87^{\circ}15'$ — $87^{\circ}25'$ ) was covered by reconnaissance gravity and magnetic surveys. The tentative results of the surveys are : (1) The maximum possible thickness of the alluvial sediments in the area of survey is about 4,000 feet; (2) there are indications of buried hills—relict topography on the basement complex—about 8 miles north-east and northwest of Kharagpur; and (3) the relief of the buried hills may be nearly 1,500-2,000 feet. The numerical figures may be taken to give the order of magnitude only. The geology of the peripheral regions of this alluvial tract seems to lend plausibility to the above views.

#### 11. Basement Rocks of Narmada Valley.

A. K. ROY and K. V. RAGHAVA RAO, Calcutta.

An opportunity was availed of to study the basement rocks of the Narmada Valley during the course of exploratory drilling for groundwater in 1955-56. Prior to this study the subsurface geology of this region was not known.

The depth to bed-rock in the bore-holes drilled varies from 78 to 1,056 feet below land surface. The area covered under the exploratory boreholes programme is about



3,000 square miles extending from Jabalpur ( $23^{\circ}03' : 80^{\circ}00'$ ) on the east to Timurni ( $22^{\circ}22' : 77^{\circ}14'$ ) in the Hoshangabad district, Madhya Pradesh on the west.

Rocks belonging to three distinct geological horizons—Archaeans, Vindhya and Deccan Traps—form the basement of the area under investigation. Archaeans are represented by Sausars and unclassified granites. The former comprise calc-gneisses (diopside bearing), crystalline limestones (cherty and non-cherty), phyllites (with phyllonites) and epidiorites. Interesting petrological types like (?) allanite (orthite) bearing granophyre and fluorite bearing granite, which were not previously reported from the Archaean outcrops along the northern slopes of the Satpuras are recorded here for the first time from the basement rocks. The Vindhya, below the alluvium, are represented by shales and sandstones and are occasionally covered by thin trap flows. Two distinct trap flows are recognised on either side of the present course of the Tawa river.

## 12. Stratigraphy and Tectonics of the Dongargarh Series : A new Series in the Pre-Cambrians of Madhya Pradesh.

S. N. SARKAR, Kharagpur.

As a result of detailed structural mapping and petromineralogical study of pre-Cambrian rocks over an area of 800 square miles (covering mainly the Topo Sheets 64 C/7, C/8 and C/12), and reconnaissance survey over another 400 square miles (including parts of 64 C/3, C/4, C/11, C/15 and C/16) in Bhandara, Drug and Balaghat districts, Madhya Pradesh, a new series of rocks has been established by the author and named the Dongargarh Series. These rocks were previously considered to be of Sakoli age. In this communication a very brief outline of the stratigraphy and tectonics of the area is given.

The Dongargarh Series with the granites constitute a belt upto about 45 miles wide stretching NNE for more than one hundred miles between Sakoli Series belt on the west and Chandarpur Sandstone—Raipur Limestone belt on the east. From the sequence established on the basis of excellent top and bottom criteria available in the different rock groups of the area the Dongargarh Series is found to be post-Sakoli and pre-Vindhya in age. Distinct lithologic identity of the series and the presence of two conspicuous angular unconformities, one at the base, and other at the top of the series, strongly support the above idea. The stratigraphic thickness of the Dongargarh Series is calculated to be about 40,000 feet, which may be divided into two broad groups. The Lower group consisting of the Rhyolite and Lower Andesite formations, is separated by the emplacement of the granites from the Upper group comprising the Lower Grit, Middle Andesite, Upper Grit and Upper Andesite formations.

From all the available stratigraphic, lithological and structural data four different orogenic cycles are recognisable, at least the first three of which must have been separated by long time intervals.

## 13. The Tectonic Pattern of the Ghatsila-Galudih Area, East Singhbhum, Bihar.

S. N. SARKAR, Kharagpur.

Intensive structural study of the Ghatsila-Galudih area and reconnaissance survey of the surrounding region in East Singhbhum by the author throws new light on the tectonic evolution of the region. The country rocks mainly include para- and ortho-metamorphites of the Chaibasa stage, in which three different S-planes and eight types of lineations have been recognised and mapped.  $S_1$  (bedding) and  $S_2$  (cleavage) planes make high angles between them near the noses

of folds, and tend to be subparallel in the limbs. The lineations due to (i) minor fold axes and (ii) intersection of  $S_1$  and  $S_2$  have been grouped as b-lineation, which is parallel or subparallel to the regional fold axes (B) having a general trend between ESE and SE. The lineations due to (iii) elongated boudins, (iv) slicken-sides and minor grooves, (v) dimensional orientation of minerals and (vi) rare minor puckers on  $S_2$  have been grouped as a-lineation that represents the direction of tectonic transport. Unlike ideal cases, here the angle between b- and a-lineations on  $S_2$  generally varies from  $70^\circ$  to  $90^\circ$ . The lineations due to (vii) prominent puckers and (viii) minor folds on  $S_2$  are grouped as l-lineation which is super-imposed on the b- and a-lineations and is found to be independent of them.

On the basis of excellent top and bottom criteria fourteen different quartzite horizons with their directions of younging have been indentified. Major structural units, (serially numbered) as revealed by careful study of all the available field data are as follows. In Ghatsila area from SW to NE the three units are: (1) Doubly plunging Ghatsila syncline forming an elongated asymmetric normal canoe fold with B axis trending approximately SE; (2) Maubhandar anticline with SE to eastward trending B axis; and (3) southern limb of Dalma synclinorium the B axis of which lies 10 miles to the NNE, just south of Dalma thrust. Between Galudih R.S. and Kaspani; (4) Galudih anticlinorium consists of ten synclines and as many anticlines with their B axes plunging  $10^\circ$  to  $55^\circ$  SE to ESE. This anticlinorium when traced towards SE actually forms a part of the limb of Dalma synclinorium. From Longitude  $86^\circ 25'$  southeastward the units met with are: (5) Bankati depression (of the fold axes B) with B' axis trending NE to NNE giving rise to spectacular curvature of the formation boundaries, and of S-planes and lineations; (6) Denli culmination zone with B' trending NE and (7) Paharpur depression zone whose B' axis gradually changes from ENE to NNE. From NW to SE, within 12 miles, the arcuation of the zones and the intensity of the cross folding (along B') of the regional fold axes (B) gradually increases and reaches its maximum in the Paharpur depression near Long.  $86^\circ 40'$ .

Since Dalma thrust abruptly cuts across the large canoe folds formed by cross folding (along B') it is undoubtedly younger than the latter. All the available data strongly suggest three principal stages of movement in the tectonic evolution of this region. A provisional and generalised sequence of events is given in the conclusion.

#### 14. Note on Porphyritic Granite in the vicinity of Tulin, Manbhum District.

DILIP KUMAR SEN GUPTA, Kharagpur.

The paper deals with the structure of the porphyritic granite which crops out as irregular, tortuous veins associated with the older migmatites and granite gneisses in the vicinity of Tulin, Manbhum district.  $S_2$ -planes (secondary foliation or schistosity) of the granite gneiss generally show East-West strike with vertical to steep dips and are mostly parallel to  $S_1$ -planes (Relict primary bedding or banding) except near the fold axes.

The porphyritic granite has primary flow layers indicated by mafic minerals, developed particularly at the borders, sub-parallel to the contact planes. Biotite-rich bands have been faulted along the granite boundary; a few inclusions in the porphyritic granite are found to have moved with reference to the regional foliation of the granite gneiss. Q-joints occur sub-perpendicular to the direction of the primary flow layers.

Minor faulting of biotite-rich bands, primary flow layers parallel to the boundary and the movement of inclusions suggest magmatic origin of the porphyritic granite. Q-joints might have resulted from the rupture brought about by the movement during the late solid stage.

**15. Tectonic Studies in the French Pyrenees—the Region of Sentein (province of Ariège).**

S. N. VISVANATH, Calcutta.

A detailed study of the lead-zinc mining district of Sentein in Ariège province of the French Pyrenees was carried out in the years 1952-55; the tectonic features of the area are presented in this note.

The stratigraphic sequence is made up of an enormous thickness (exceeding 6,000 ft.) of infra-Devonian schists, phyllites, limestones and conglomerates. The total absence of fossils renders correlation a delicate task. The formations have suffered considerable deformation as a result of the Hercynian and Pyrenean (early Alpine) movements. Presumably, there were pre-Hercynian movements also, but their manifestations are almost completely blotted out. Through all this deformative process, the absolute concordance of the different stratigraphic units is faithfully preserved.

A system of anticlines and synclines with the axes trending East-West and having a plunge towards the East developed as a result of the Hercynian movements; on this was superimposed an orthogonal system of faults, one set striking approximately East-West and the other North-South. These major features—along with minor features such as schistosity, jointing, lineation—are described in detail. The relation between tectonics and sedimentation is discussed and a short note on the tectonic evolution of the area given.

**(ii) Palaeontology and Palaeobotany**

**16. On the occurrence of Organic Remains in the Gangetic Alluvium near Mokameh, Bihar.**

P. K. CHATTERJEE, Calcutta.

A few pieces of vertebrae and carbonised wood were obtained from depths below sea level in the bed of the Ganga River at Hatidah near Mokameh in course of sinking wells for the construction of piers of the Rail-cum-Road bridge. The vertebrae are supposed to belong to bovid, most probably *Bos* (identified by C. Tripathi, Geological Survey of India) and the carbonised wood represents *Acacia* (identified by K. A. Choudhury, Forest Research Institute and C. Nageswara Rao, Geological Survey of India). These finds indicate the age of the beds from which they have been obtained to be equivalent to that of Older Alluvium.

**17. Fossils of the Upper Cretaceous (Cenomanian) Utatur Group at Karay, Trichinopoly District.**

A. CHAUDHURI, Calcutta.

Fossil Belemnites, Tubulostium, Gryphaea, echinoid spines and Oxyrhina have been obtained from the gypseous clay bands at the base of Utatur group at Karay (11°05' 78'55), Trichinopoly dist.

H. P. Blandford (1861) described Belemnites from about the same horizon in other localities but none from the present one. Again, he conceived that the Belemnites were "confined to a restricted area, characterized by the deposition of fine silts and the comparative absence of other forms of marine life." Here, in the clay bands, however, Belemnites are associated with the marine forms as well.

The species of Belemnites in the present area are identical with those described by Blandford from other localities, and are associated with the species of Gryphaea,

Tubulostium, echinoid spines and Oxyrhina, described by Stoliczka from the Utatur beds in general.

**18. Plant fossils of the middle Jurassic (?) Utatur Gondwana Plant-beds at Terney clay-pit, Trichinopoly District.**

A. CHAUDHURI, Calcutta.

Cycadean plant fossils were collected at Terney (11°05' : 78°54') clay-pit situated about one and a half miles to the east of the said village. The depth of the clay-pit at the time of collection in May, 1956, was 55 feet from the surface; the clay being quarried for the Dalmiapuram Cement Works. All the plant fossils observed, except one doubtful Taeniopteris, are Ptilophyllum acutifolium of middle Jurassic (?) age.

**19. A note on the Kirthar Foraminiferal Limestone of Lakhpat, N. W. Kutch.**

BARUN SEN GUPTA, Kharagpur.

In the vicinity of Lakhpat (23°49'30"N : 68°46'29"E), south of the Great Rann of Kutch, Eocene (Kirthar) foraminiferal limestones have excellent exposures. The rock is mainly an impure argillaceous limestone made up, almost wholly, of tests of larger foraminifera. Fossils of lamellibranchs, gastropods, echinoids etc. are also associated.

The foraminiferal fauna is impressive not only because of the abundance of individuals but also because of the presence of quite a number of species to which these belong. Assilina, Discocyclina and Nummulites are profusely distributed genera. Alveolina shows remarkable concentration in some spots where it makes up the bulk of the faunal content, and this possibly indicates the prevalence of a shallow water condition at such places.

The more important microspheric species are :—Assilina exponens, A. cancellata, Discocyclina dispansa, D. javana, var. indica, D. sowerbyi, Nummulites stamineus, N. acutus, N. maculatus. Megalospheric equivalents are present in the cases of Assilina and some Nummulites. The Alveolina tests examined are all megalospheric and belong to A. elliptica. From this assemblage, the age of the beds is fixed as the lower part of the Middle Kirthar.

**(iii) Mineralogy**

**20. On the Microcline Porphyroblasts with Myrmekitic Rims of the Granitic Rocks of Lohardaga, Ranchi District, Bihar.**

P. P. AGRAWAL, Patna.

Microcline porphyroblasts surrounded by myrmekitic rims are the dominant potash-feldspars of the granitic rocks of Lohardaga, Ranchi district. Cross-hatching is prominently developed in the microcline feldspars. The optic axial angle has been determined on the Universal stage; the value came around 86°. The microcline feldspar is always younger than the other constituents of the rock. It is seen replacing the plagioclase and also accompanied by muscovitization of plagioclase and formation of myrmekite.

Microcline porphyroblasts surrounded by myrmekitic rims originate probably at low temperature on microcline granites through granitization of leptitic rocks. The myrmekites of this granite are a result of K-Al-metasomatism.

- 21. Study of the Magnetite-Martite-Goethite relation in the iron-ores of Badampahar, Mayurbhanj, with a note on the primary nature of the ore.**

KANAI LAL CHAKRABORTY, Jadavpur.

The iron ore of Badampahar ( $22^{\circ} 07' 07''$  :  $86^{\circ} 07' 50''$ ) in the district of Mayurbhanj, occurs as bands, alternating with silica in the banded hematite-quartzite, and also as massive deposits concentrated from the latter. The mineralogy of the ore and the textural relationship among the minerals were studied under the ore-microscope. The paragenesis of the minerals and the primary nature of the ore was deciphered.

- 22. Note on the occurrence of allanite in and around Kuilapal Granite-gneiss.**

PRIYA SANKAR CHAKRAVORTY, Jadavpur.

The Kuilapal granite-gneiss at the trijunction of Bankura, Manbhum and Midnapore districts has a more or less elliptical outcrop. Mineralogically the granite is chiefly constituted of quartz, plagioclase, microcline, and biotite; garnets, muscovites and hornblendes are occasional; epidote, allanite, sphene, zircon and apatite are accessories while chlorites and sericites are secondaries. The accessory allanite is of special interest because it is also found in the surrounding mica-schists and in the calc-granulites occurring as inclusions within the granite-gneiss. Proportion of allanite diminishes from the granite-gneiss boundary outwards. This variation is more marked in the calc-granulites, the proportion of allanite increasing from centre of the bands towards the contact with granite. These allanites in rocks are often metamict and isotropic with  $N 1.65$ . They often occur as cores in epidote grains. The allanites are occasionally found also in pegmatites occurring within the Kuilapal granite-gneiss. A preliminary examination of the mineral in  $\beta$ -ray counter indicates that the mineral is radioactive with a strong  $\gamma$ -ray background.

- 23. Ore-microscopic studies of the Tin-bearing mineral occurring in the neighbourhood of Paharsingh and Nawadih of Ranchi District, Bihar.**

S. DEB, Jadabpur.

Tin-bearing mineral, primarily cassiterite ( $\text{SnO}_2$ ) occurs along the hill-range of Paharsingh and Nawadih areas of Ranchi dist., situated at a distance of about 27 miles from the Ranchi town on the road to Purulia.

The country rock which is mostly calc-silicate rocks containing andalusite, diopside, wollastonite with some amount of free calcite, biotite being accessory. The country rocks are invaded by numerous pegmatite veins which usually follow cracks and fissures in the country rocks. The veins are sometimes very thin of about one foot or less in thickness to  $2\frac{1}{2}$  to 3 ft. These veins are discontinuous and do not follow any definite direction, pinching out at a depth but sometimes reappearing at a deeper region. Cassiterite occurs in the greisen of the pegmatites which forms a soft and decomposed material containing quartz, mica crystals, tourmaline, and a small amount of feldspar. Cassiterite occurs in veins where there is muscovite in excess and tourmaline in less quantity. The big pegmatite bosses on the other hand do not contain any cassiterite. Eluvial deposits found on the hill slope and on the foot of the hill contain in some places a rich concentration of cassiterite, the average percentage being 0.25. These gravel beds are richer in tin content than the greisen deposits found at the top of the hills.

Under the ore-microscope, polished sections of cassiterite shows a greyish brown colour with strong anisotropism, producing a faint yellowish brown to whitish colour effect. Grain boundaries are well marked and sometimes straight. Twinning is common to all the crystals. Inclusions of other minerals are practically absent. The reflecting power as determined by the Berek-Slit-Photometer gives a value of 10.8% in air under green light. This value is almost similar to that mentioned by Folinsbee.

As regards the origin, the cassiterite deposits of this area can be classified as pyrometasomatic type of Lindgren being formed by the gaseous transfer of materials from the magma by pneumatolitic process.

#### **24. Ore-microscopic studies on Ilmenite from Sambalpur District, Orissa.**

BANKIM MUKHERJEE, Jadavpur.

A few samples of ilmenite collected from Sambalpur district by a field party were polished and studied under the ore-microscope. Several minerals were conclusively identified by optical characters, etch reactions and reflectance measurements by Berek's Slit Micro Photometer under green light. The minerals are Ilmenite, Hematite, Goethite, Rutile and Lepidocrocite. Ilmenite is the predominating mineral and Hematite and Goethite are next in abundance. Rutile occurs as vein like replacements in Ilmenite. Lepidocrocite occurs in Goethite. The reflectance percentages for the minerals were as follows: Ilmenite—18.3%, Hematite—25.7%, Goethite—17%, Rutile—20.8% and Lepidocrocite—21%.

As for the mineral paragenesis, ilmenite is the earliest formed mineral. Hematite occurs along the grain boundaries of ilmenite and replaces it. Goethite is also secondary from ilmenite and is a much later product. Lepidocrocite is perhaps simultaneous with goethite. Relation between hematite, goethite and rutile could not be established due to their isolated occurrences.

#### **25. A note on the occurrence of Magnetite within the porphyroblastic gneisses around Burkadihi, Ranchi District.**

A. K. MOOKERJEE and S. GANGULI, Kharagpur.

Mineragraphic study of the magnetites within the porphyroblastic granite-gneiss reveals the following salient features, significant from the point of view of genesis of the rock :

(a) Although the most of the  $TiO_2$  has formed exsolution plates of ilmenite, the magnetite is still somewhat titaniferous.

(b) The ilmenite lamellae mostly tend to segregate towards the grain boundary of the magnetite crystals and form irregular grains, giving rise to rim texture.

(c) Those lamellae, well within the host crystals, are oriented parallel to (111) direction of magnetite.

The whole phenomenon can be attributed to retrogressive changes accompanying granitisation. The extremely slow rate of cooling was responsible for the incomplete ex-solution and marginal concentration of the ilmenite plates. The study thus offers a corroborative evidence in favour of granitisation of the host rock.

#### **26. Clouded Serpentine from Byrapur, Mysore State.**

B. P. RADHAKRISHNA, Bangalore.

The phenomenon of clouding is commonly observed in intermediate plagioclases. There are, however, few records of instances of clouding in other minerals. The paper describes peculiar purplish coloured serpentine from shear zones in the

serpentinites of Byrapur, Mysore State, which are intensely clouded with dark dust and similar in every respect to the clouding observed in the plagioclases of some of the dyke rocks in Mysore. The restriction of the deeply clouded serpentines only to the sheared portions which formed channelways for the passage of late magmatic solutions is stated to indicate the clouding of serpentines to be the effect of late magmatic activity.

**27. On the occurrence of Magnetite deposits in Mt. Girnar, Saurashtra.**

A. K. ROY, Calcutta.

Magnetite deposits are found to occur in Girnar Hills, east of Junagarh town in Saurashtra. They occur in the north-western part of Girnar Hills near Bhabanath temple, (Lat.  $21^{\circ} 02'$  : Long.  $70^{\circ} 31'$ ) at the foot of Jatasankar Hill which is composed mainly of basalt. There are reported occurrences of magnetite as minor accessories in almost all the rock types of Mt. Girnar by different authors. But here, as seen from the magnetic effects on clinometer in the field, it appears that the whole hill (Jatasankar) is magnetic from the base to the top with segregated pockets of magnetite deposits. The ore body consists essentially of magnetite-ilmenite intergrowth with some secondary alteration to limonite. The polished sections of the ore body have been studied and a petrographical description of the associated basic rock is given. The occurrence of magnetite in such richness in this part of Mt. Girnar has not yet been reported.

**28. Mineragraphic study of Copper and Lead ores west of Benatanagar, Singbhum District, Bihar.**

SUPRIYA ROY and BIMALENDU SARKAR, Jadavpur.

Copper and Lead ores occur in a quartz vein, striking N-S in sheared epidiorite, about half a mile to the west of Benatanagar ( $22^{\circ} 40'$  :  $85^{\circ} 31'$ ) and  $1\frac{1}{2}$  miles SSE of Karaikela ( $22^{\circ} 42'$  :  $85^{\circ} 32'$ ) in Singbhum district, Bihar. Studies of polished sections of these Copper-Lead ores under reflected light revealed the presence of the following minerals: Pyrite, Chalcopyrite, Galena, Neodigenite, Pentlandite and Covellite. Pyrite occurs as rare crystals in close association with quartz and is veined by chalcopyrite. Chalcopyrite occurs as the most abundant mineral. Galena comes next in abundance and occurs as subhedral to irregular bodies replacing the chalcopyrite. Galena, at some places, assumes a purple colour suggesting the presence of Tellurium. Neodigenite, characteristic by its blue to bluish grey colour, isotropic nature, and reflecting power of 24.2% in green light in air, replaces both galena and chalcopyrite. Galena is replaced by neodigenite along the crystallographic planes and also in an irregular pattern. Chalcopyrite is traversed by numerous minute veins of neodigenite. Pentlandite, exhibiting typical brassy colour and a high reflecting power has been found to replace both galena and neodigenite, and is therefore later than both of them. Covellite, occurring as minute crystals lining cracks and vugs and exhibiting the typical indigo blue colour and strong anisotropism is probably one of the last minerals to crystallise.

The paragenesis of the ore minerals, therefore stands as follows:—

Pyrite	Chalcopyrite	Galena	Neodigenite	Pentlandite

No relation of the covellite with neodigenite or pentlandite could be established. So it could not be shown in the sequence of crystallisation.

**29. Studies on the nature and distribution of mineral matter in Indian Coals.**

P. SEN and A. N. ROY, Kharagpur.

The nature and distribution of mineral matter in different size fractions obtained on crushing and screening of coals procured from Jharia, Bokaro, Raniganj, Madhya Pradesh and Hyderabad have been investigated. It has been of considerable interest to find that the general trend in the variation of mineral matter content from coarser to finer size fractions is similar for the coals from Jharia, Bokaro and Raniganj. The ash content gradually decreases in the finer size fractions upto +200 mesh and the extent of variation between the maximum and minimum ash values is about 12 per cent. In fines, below 240 mesh, there is again a slight increase in ash content.

In the case of Madhya Pradesh coals, the trend of variation is different. The ash content increases in the finer size fractions and the maximum variation in ash values is about 14.0 per cent between +5 to -300 mesh sizes.

In coals from Hyderabad, there was practically no variation in ash content with size degradation up to +300 mesh. In fractions below -300 mesh, there was a sharp increase in ash from 28 per cent to 37.2 per cent.

The petrographic constituents in the various coals have been assessed by employing the B.S.I. Method. Also, X-ray analysis of some of the coals have been carried to study the nature of the minerals.

(iv) Petrology

**30. A Preliminary note on the Charnockites of Kurarhmal in Khurda Sub-division, Puri District, Orissa.**

S. ACHARYA, Patna.

The author has done a preliminary study of the Charnockites around Kurarhmal village, 7 miles south of Khurda, Orissa. Prior to his work, P. K. Chatterjee had worked upon these rocks and according to him these rocks were products of magmatic differentiation. In the field the author has observed the gradation from basic to acid types of the Charnockites. The stages of hypersthénization of the clinopyroxenes-diopsides are seen under the microslides. Due to metamorphism, garnet, biotite, secondary quartz and magnetite have resulted. The presence of incomplete and bent twinned lamellae of plagioclase and myrmekites are diagnostic features of metamorphism.

**31. A note on the Deuteric mineralisation and its bearing in the genesis of Magnetite ore in the Dublabera Gabbro and Anorthosite, Singhbhum District, Bihar.**

T. C. BAGCHI, Kharagpur.

The vanadiferous iron ores of Dublabera are associated with altered quartz gabbro and quartz anorthosite. Petro-mineralogical studies show that the alteration is due mostly to deuteric changes in the gabbro which were responsible for the formation of a part of the ore, but residual solutions from the gabbroidal magma perhaps gave rise to the bulk of the iron ore.



**32. On the occurrence of Ovoid Nepheline crystals in Limestone along the contact of the Alkaline Syenite Rock of Kishengarh, Rajasthan.**

T. C. BAGCHI, Kharagpur.

An exposure of limestone with ovoids of nepheline, 850 sq. yds. in area, and one foot in thickness, lie at the immediate contact of the Nepheline Syenite near Ransamed Talab, in Kishengarh, Rajasthan. The longer diameter of the ovoids usually ranges from 0.1"—1" or even more. The ovoids are often glomerogranular and are partly or wholly replaced by cancrinite. A large number of the nepheline crystals are poikiloblastic containing unreplaced relics of limestone matrix. Field and microscopic evidences indicate that the ovoids were formed by a process very similar to nephelinization as suggested by Eckermann. Emanations rich in Na, CO<sub>2</sub>, H<sub>2</sub>O etc. originating from the residual solutions, at the later stage of the formation of the nepheline syenite, permeated the limestone and replaced parts of the rock partly or completely thus giving rise to poikiloblastic or ovoid shaped nepheline crystals. The ovoid shape is ascribed to the weak force of crystallization of nepheline or its marginal alteration to cancrinite.

**33. Some thoughts on the origin of the gneissic rocks of Ranchi Plateau, Bihar.**

T. C. BAGCHI, Kharagpur.

Detailed field and microscopic observations on rocks of parts of the Ranchi plateau and adjacent areas have indicated that the hitherto contemplated mode of genesis of the Chota Nagpur Granite Gneiss can be questioned. The extreme heterogeneity in composition of the granulites and gneisses, the presence of lenses of quartzite and calc-granulite in the porphyroblastic gneiss having structural harmony with them, the wide-spread development of felspar metacrysts in the pelitic enclaves and their gradual conversion to granite-looking rocks with still preserved 'ghost' relics, the progressive change of feldspathised migmatites to 'pods' of granite along the strike, the highly isoclinal folded nature of different rock varieties, all considered together possibly indicate a syntectonic granitisation of geosynclinal sediments, in all probability connected with the Satpura Orogenic Cycle.

It appears that pelitic, semi-pelitic and psammitic sediments have mostly contributed to various rock types of the Ranchi plateau. These sediments were, not only, thrown into isoclinal folds but, concomitant with the folding, were also granitised. The psammitic rocks were little affected; the pelitic and semi-pelitic schists were permeated with granitic fluids and were gradually made over to porphyroblastic gneiss which in its turn, with increased development of mobility, changed into normal igneous looking granite. A portion of the folded sediments might have been thrust deeper down into the crust, where, perhaps, actual fusion of the sediments took place and thus resulted in the formation of the widespread coarse-grained uniform granite near Palkot.

Evidences indicate that in the Ranchi Plateau there has been a general increase in mobilisation from east to west.

**34. A note on some sands collected from two bore holes at Hijli, Kharagpur, West Bengal.**

T. C. BAGCHI and C. NARASIMHA RAO, Kharagpur.

Coarse to medium grained sands were encountered at a depth of 200-250 feet in two bore holes sunk at Hijli, near Kharagpur. The sands show polymodal

grain distribution, which is suggested to be due to their derivation from more than one source, as well as a varied transportation history in a fluvial medium consisting of both traction and suspension load. The heavy minerals group themselves clearly into 2 natural suites: (1) those derived from reworked sediments e.g. zircon and tourmaline and (2) those derived from high grade metamorphic rocks e.g. staurolite, kyanite and sillimanite. In addition, the presence of zoisite, blue zircon, and corundum are noteworthy.

The extreme angularity of quartz grains, with high sphericity values is in conformity with the observations of Thiel (1940) and Pettijohn (1948).

### 35. Textural variations in some Barakar Sandstones in the South Karanpura Coalfield, Bihar.

INDRANIL BANERJEE, Calcutta.

The Barakar sandstones occurring in the eastern part of the South Karanpura coalfield basin (Lat. N  $23^{\circ} 30'$  to  $23^{\circ} 40'$  and Long.  $85^{\circ} 25'$  to  $85^{\circ} 45'$ ) were sampled to bring out significant textural variation. The size-parameters used, as obtained from 25 mechanical analyses are the median diameter, sorting index and the modal diameter. The median diameters vary widely from 0.98 mm. to 0.12 mm. with an average of 0.62 mm. Sorting indices vary from 1.70 to 4.50. Modal diameters have a range from 1.22 mm. to 0.15 mm., the average being 0.55 mm., the spread about the average being small. The grain size-distributions in the samples are all slightly asymmetric but the skewness values are more or less constant, for all the samples.

The variations as shown by the sample are due to actual inhomogeneity of sediments and not to the operational error which was determined and found to be much lower.

The areal variation shown by the medians, the modes and the sorting indices plotted on the map, does not fall into any definite pattern except that there are two areas of concentration of coarser sediments near the boundary of the basin.

Though the other size-parameters fluctuate, the value of the maximum grain diameter in samples remains relatively constant. Because, whereas the average grain diameters have complex relationship with the hydrodynamic factors, competence of the stream is directly and simply related to the stream velocity. Observed data also agree with the extreme-value distribution (Krumbein and Leibin, 1956) implying that these gravels are normal parts of the local deposit.

### 36. Petrographic studies of the Sand-fraction of the soils in the Son Valley of the Mirzapur District (U.P.).

N. BHATTACHARYA, Varanashi.

The present mineral studies relate to the soils developed over the Lower Vindhyan rocks of the Son valley of the Mirzapur district in Uttar Pradesh. It extends over an area of about 15 square miles placed between the north latitudes of  $24^{\circ} 27'$  to  $24^{\circ} 37'$ ; and east longitudes of  $83^{\circ} 5'$  to  $83^{\circ} 12'$ . The soils show a wide variation in colour, texture, mineral composition, and consistency. They are often grey in colour over the higher elevations of Gurma with a massive and crumbly texture, while that on the lower elevations of Markundi are brown and generally friable to crumbly. As one proceeds towards the Son river, there is often a general increase in the quartz content as the soil becomes more leached and more friable. The minerals have generally been concentrated in the lowlands of Gurma, Markundi and Chopan. The mineral facies show a variation not only in their quality, but also in angularity, size and mutual relationships.

The most common minerals of the sand fraction are quartz, limonite, calcite, dolomite, chloritoid, clinochlore, orthoclase, microcline, plagioclase, apatite, muscovite, tourmaline, jadeite, actinolite, chrysoprase, and chalcedony. There are also some cryptocrystalline quartz together with some argillaceous and ferruginous materials. Some of the grains of quartz of the surface soils show 'secondary enlargement' which is very common over the higher elevations of Markundi and Gurma. There are also other secondary minerals like sericite, siderite, and clay minerals.

The soils have been classified into four major groups mainly on the basis of their mineral characteristics. Their relationships to geological and physiographic elements have also been considered. The first group is rich in quartz and limonite, and calcite comes into prominence in the 'B' horizon. The second group has such minerals as chloritoid, limonite, and plagioclase, and less commonly quartz, muscovite, calcite, and apatite. The third group has both light and heavier minerals almost in equal proportions. The fourth group is dominated by heavy minerals like limonite, haematite, tourmaline, clinochlore, and actinolite. It is further characterised by poor clay content.

This fourfold division of the soils would appear to be somewhat arbitrary and hypothetical. Further investigation and research are expected to throw more light on the validity of this classification.

### 37. Petrography and sedimentation of the Vindhyan Rocks of the Son Valley in the Mirzapur District, Part I—The Semri Series.

N. BHATTACHARYA, Varanashi.

The Semri Series is composed of calcareous rocks of shallow water deposition. The associated rocks are mostly limestones, shales, porcellanites, and conglomerates covering a thickness of 4,000 feet. There are three varieties of limestones: granular limestones, crystalline dolomitic limestones, and fragmental limestones, each having a diagnostic mineral suite, texture, and chemical composition. The limestones are harder towards Chopan than elsewhere.

While some of the limestones are the ordinary clastic varieties, there are others which are partially dolomitised. The latter varieties often show the formation of 'secondary calcite'. The textural features also indicate that dolomitisation took place and the change was subsequent to the deposition of the original rock. The 'secondary' formation of the grains of calcite and dolomite was by recrystallisation which started from the centre towards the periphery of the grains. The result is a hard limestone rock. Only scattered grains of quartz bear witness to the original clastic nature of the rocks. Some of the metasomatic varieties of limestones show a change from opal to chalcedony and finally to quartz—a fact which again speaks of recrystallisation.

### 38. Petrography and sedimentation of the Vindhyan Rocks of the Son Valley in the Mirzapur District, Part II—The Kaimur Series.

N. BHATTACHARYA, Varanashi.

The Kaimur rocks of the Son valley in the Mirzapur district cover much area in the neighbourhood of Markundi and Gurma. The topography is very irregular and consists of rugged terrains with very steep scarps here and there. The rocks are composed of sandstones, shales, quartzites, and conglomerates having a total thickness of about 1,400 feet. The rocks have a varying mineralogical composition and structural relationships. The area in the north and south have been much affected by faulting.

The orthoquartzites are fine-grained and have cryptocrystalline silica as the cementing material. In other types, the cementing material is either ferruginous or argillaceous and the grains are rounded in shape. Grains of the strained variety of detrital quartz are often crushed and have a jagged appearance. The other variety of quartz show primary detrital grains which have been rounded, secondarily enlarged, and again rounded. Feldspars are scarce; when present, they are either plagioclase or microcline. The carbonates are calcite, dolomite, and siderite. Some of the carbonates have replaced detrital quartz, and authigenic quartz has further replaced calcite. The other minerals are tremolite, ilmenite, haematite, limonite, sericite, and leucoxene.

The rocks were deposited under a fluvial environment and there were rapid changes in direction and transporting competence of the turbulent currents. There was no free mixing of the aerated water with either the alkaline- and carbonate-saturated water or the silica-saturated water. This in the early stage of diagenesis led to the replacement of calcite by authigenic quartz.

### 39. Study of metamorphism around Champua, Keonjhar.

MIHIR KUMAR BOSE, Calcutta.

The oldest rock series of the Archaean terrain around Champua ( $22^{\circ} 04' : 85^{\circ} 40'$ ) is constituted of metamorphics, mainly pelitic in composition with local arenaceous and calcareous variants. The foliation strikes NNW-SSE for the major part of the area and curves round to East-West to the south. The parametamorphic schists show a high grade of metamorphism as marked by the development of sillimanite in the eastern part of the pelitic tract, the prevalent rocks to the west being quartz biotite schists, but still belonging to the albite-epidote amphibolite facies (Eskola). The calcareous bands are almost always characterised by the presence of pyroxene ( $2V_z = 59^{\circ}$ ,  $Z_{Ac} = 42^{\circ}$ , Salite) and show as many as eight different mineralogical assemblages. The amphibolites show structural concordance with the pelitic rocks and some characters of para-amphibolites. The critical mineral formation in the rock groups have been strongly guided by the bulk composition of the sediments and the zonal index minerals did not always develop in the corresponding grades. The metamorphic development was followed by a granite invasion—the gneissic granite (part of Singbhum granite) with a number of paraschist inclusions extending to the east of the tract.

### 40. On basic and ultrabasic intrusives of Champua, Keonjhar.

MIHIR KUMAR BOSE, Calcutta.

The Archaean rocks around Champua ( $22^{\circ} 04' : 85^{\circ} 40'$ ) have been intruded by a number of dykes, basic to ultrabasic in composition. The basic intrusives have a major North-South trend and form a part of the Newer Dolerite series. They almost always show some amount of alteration mainly in the form of chloritisation of clino-pyroxene ( $\gamma = 1.711-1.726$ ,  $2V_z = 59^{\circ}$ ,  $Z_{Ac} = 40^{\circ}-43^{\circ}$ ) and saussuritisation of plagioclase, the alteration being more marked in bodies intrusive into the pelitic metamorphics than those in the gneissic terrain, with a gradually increasing degree of chloritisation towards the margin of the bodies. The ultrabasic bodies are often fresh and the major bodies show a mineral assemblage—enstatite ( $\gamma = 1.680$ ,  $2V_z = 74^{\circ}$ ), olivine ( $2V_x = 86^{\circ}$ ) and a diopsidic augite ( $\gamma = 1.692$ ,  $2V_z = 44^{\circ}$ ,  $Z_{Ac} = 40^{\circ}$ ) and much altered plagioclase and hence are of picritic composition. The major bodies show hardly any systematic variation of grain-size or mineral proportions across the trend. A few other small occurrences of ultrabasics with

varying mineral composition have also been noted. The ultrabasic intrusives are free of deformation or metamorphic imprint and are younger in age than the Singhbhum granites like the Newer Dolerites.

#### 41. Petrography of the Lavas of Pavagad Hill.

S. C. CHATTERJEE, Patna.

In this paper the author gives a petrographical description of not only the rhyolites and basalts which have already been described by Fernor and Dubey, but also of trachytes, trachy-andesites and anakaramites which have been recorded by the author for the first time as occurring in situ. Moreover the author has shown that the trachytes, rhyolites, basalts and olivine basalts are all interbanded and do not form a progressive differentiation series.

#### 42. A Note on the Preliminary Studies of the Injection Gneisses, Rihand Dam Site Area, Mirzapur District, Uttar Pradesh.

ARUP DEB, Banaras.

The paper deals with the petrographic studies and the origin of the injection gneisses of the Rihand Dam Site area. The area lies about 70 miles south of the Mirzapur Town, on Lat.  $24^{\circ} 12'N$  and Long  $30^{\circ} 3'E$ . The width of the river bed at the Dam site is 1,200 ft. and its elevation is 630 ft. from mean sea level. The structure represents a simple type of folding with its axis running practically E-W.

The mica-schists are found to overlie the gneissose granites. There is gradational and transitional change of the mica-schists to gneissose granites with the intermediate stages of injection gneisses and gneisses. These injection gneisses are formed by the lit-par-lit granitic intrusion along the interfolial planes of the schistose rock and by the stoping of the wall and roof of it. Strike of the plane of its foliation is E-W, but locally it is variable. Pegmatite and aplite veins with pygmaic foldings are common.

Petrographic studies of the injection gneisses show a granoblastic texture, abundance of albite and orthoclase metacrysts together with the laths of green biotites. Secondary changes due to the hydrothermal action are evidenced by the myrmekitic and micropertilitic intergrowths, and by the kaolinization and sericitization of the feldspars. Owing to the magmatic intrusion along the foliation planes of the country rocks, it has regionally developed migmatites.

There is an increase in the iron content along the zone of contact. Locally, there is development of an iron-rich zone exposed on the western side of the Inspection House (1,100 ft. to the north of the Dam axis) and at the north extremity of the Labhri Hill range (left bank).

There is increase in the iron content in the injection gneisses as well, as found by the micrometric analyses.

#### 43. Application of phase rule on the mobility of components.

AMITAVA DUTT.

The mineralogical phase rule has been applied to the study mobility of elements in rocks both igneous and metamorphic, when different stages of a particular petrological set up remain unaffected and retained. These stages may be compared with each other and an idea of the mobility of components may be obtained. This, of course, holds good when equilibrium conditions are reached.

Some of the important conclusions may be observed thus :

(1) A constant number of components in a system, at high chemical potentials will form lesser number of phases than those at lower chemical potentials.

(2) The stages leading to the final assemblage of phases will show a variation in the number of phases by 1 in equilibrium conditions and this variation shows a linear tendency.

(3) The number of phases is fixed by the number of inert components (which fall within the range of average value).

(4) Using the relation between the atomic or ionic radius of components and the mobility, and the relation between the radii, distance travelled and the mobility of the components, formulae may be worked out, leading to the "theory of mobility" which controls rock formations and derivatives, both metamorphic and igneous.

Various types of occurrences have been dealt with in the original paper including a type case of ultramafic enrichment around grano-diorite body ("basic front type").

#### 44. Metamorphic formations of Anthophyllite-Cummingtonite Series of Ypaja (Finland).

AMITAVA DUTT

The present writer had the opportunity to work on a petrological set-up in S-W Finland (Ypaja). Here the anthophyllite-cummingtonite series occur separately in alternate layers only around the grano-diorite body and have been noticed over 8 kms across the strike. The general run of these rocks has been intercepted by the intrusion of the former. Three gradational sub-stages follow the front set-up of anthophyllite or cummingtonite series which are (1A) Anthophyllite-Cordierite stage (or Cordierite-Sillimanite stage), (2) Anthophyllite-Cordierite-Garnet-Biotite-Sillimanite stage, (3) Biotite-Garnet-Muscovite-Cordierite stage. (B1) Cummingtonite-Hornblende stage, (2) Cummingtonite-Biotite-Magnesian-ferrite-Plagioclase stage, (3) Biotite-Garnet-Muscovite (Cordierite) stage. The affected length does not exceed 200 metres and was studied on cm scale.

Thermal effects on rocks indicate that granite is a poor source, pressure is negligible but  $\text{PH}_2\text{O}$  may be effective. Theoretical relations indicate that the higher the ionic radius balanced by partial pressure at pure state at constant temperature, the higher may be the mobility and farther they may travel. The laboratory study indicates that the above holds good in this set-up and the constituents may be written in order of mobility as, Si, Al, Mg, Fe, Na, K, OH (higher). The above three sub-stages appear to have been controlled by their respective mobilities.

Rskola (1914) suggested the theory of Mg-metasomatism for such set-up and rock formation, in the Orijarvi region. The present writer who had the privilege to work under his guidance, however, holds a different view about their formations at Ypaja, where the physico-chemical conditions apparently forbid such possibility of metasomatism. On the other hand it could be well explained by means of self-diffusion, relative mobilities of components at different stages, under the close influence of thermal, free-energy of surface and partial pressure conditions available there.

#### 45. On some Dilation and Nondilation Pegmatites in the Granitic Complex around Gumla, Ranchi District.

TUHIN KUMAR DUTTA, Kharagpur.

Different types of pegmatites occur in the granite-gneisses and migmatites of the area around Gumla ( $23^{\circ} 02' 30'' : 84^{\circ} 32' 40''$ ) in the Ranchi district of Bihar.

The most common among them are the replacement or the nondilation pegmatites which may be subdivided under two heads, viz., (a) nondilation replacement pegmatites that have cut across the foliation of the country rock without disturbing in any way the foliation direction of the adjacent rocks, (b) nondilation pegmatites which are conformable with the banding or foliation direction of the country rocks. The dilation pegmatites occurring in the area are but few, of which the concordant types generally show the pinch and swell structure in the gneiss or schist.

In the case of conformable nondilation pegmatites, relics or remnants of thin stringers of country rocks are found at places within the pegmatite bodies parallel to the regional foliation direction. Basic rims are also found to occur at the contact of such veins. Some of the pegmatites of cross-cutting nature also show clear evidence of replacement by the presence of relics or traces of the country rock in them with almost undisturbed foliation. Field evidences suggest that the growth of pegmatites in the migmatites and granite-gneisses of the area was due to one or more phases of granitisation.

#### **46. A Preliminary Note on the Metamorphism of Pelitic Schists around the Kuilapal Granite.**

SUBIR KUMAR GHOSH, Calcutta.

The distribution of the index minerals sillimanite, staurolite and garnet in the high-grade Regionally metamorphosed pelitic schists surrounding the oval-shaped outcrop of gneiss and migmatites occurring near the village of Kuilapal ( $22^{\circ} 50' : 86^{\circ} 38'$ ) in Bihar, indicates that the intensity of metamorphism decreases as one moves away from the boundary of the gneiss. The gneiss occupies the core of a foliation-anticline plunging at the two ends, and overturned to the south-west. Absence of sillimanite south and east of gneiss, and presence of staurolite-bearing rocks near the south-eastern margin may not necessarily mean a cross-cutting relationship between the gneiss-boundary and the trace of the staurolite isograd. Thus, whether in detail the isograds cut across the gneiss-boundary or not is not clear at present. After the progressive metamorphism had reached its peak giving rise to garnet, staurolite, and sillimanite, there has been considerable alteration of these minerals, particularly of sillimanite to patches of shimmer-aggregates, without signs of simultaneous deformation. Randomly oriented flakes of muscovite have grown from the shimmer-aggregates occurring near the gneiss-boundary, by static crystallisation. Localised shearing movement took place even after the crystallisation of these muscovites.

#### **47. Porphyroblastic Gneiss around Barkadih, Ranchi District, Bihar.**

LAKSHMAN SARAN SRIVASTAVA and TUHIN KUMAR GHOSH, Kharagpur.

Porphyroblastic gneiss forms the major rock formation of the area around Barkadih ( $23^{\circ} 10' 40'' : 84^{\circ} 32' 15''$ ) in Ranchi district, Bihar. Associated with the gneiss we get granitic, basic and calcsilicate rocks. An area of 35 sq. miles was mapped to study the porphyroblastic gneiss, which contains big porphyroblasts of potash-feldspars embedded in a groundmass consisting of biotite, quartz and plagioclase. Gradual transition of pelitic country rock to porphyroblastic gneiss, which again merges imperceptibly into granite, the occurrence of relics of pelitic schists with abundant felspar porphyroblasts, and the mineralogical identity of the felspar porphyroblasts, both in the enclaves and which encloses the enclaves, all indicate a probable metasomatic origin for the porphyroblastic gneiss.



**48. A short note on Basic Rocks in the Gneisses around Barkadih, Ranchi District.**

K. V. G. K. GOKHALE and T. K. ROY, Kharagpur.

Isolated patches of basic rocks occur near Barkadih ( $23^{\circ} 13' 40''$  :  $84^{\circ} 32' 15''$ ) in Ranchi district, Bihar. Field investigations revealed a marked difference in the lithology of the rock types suggesting the existence of both igneous and probable sedimentary types. The paper presents a short petromineragraphic description of the rock types and their probable origin.

The major lithologic varieties include porphyroblastic gneisses, granitic rocks, basic and calc-silicate rocks. The basic patches occur as discordant and concordant bodies in the gneisses.

From the recalculated chemical analyses, S-Al-F values have been plotted in the Osann's Trilinear diagram. Points for some basic rocks with relict ophitic texture fall in the eruptive field normally indicating their primary igneous nature. Two rock types fall outside the eruptive field and suggest a probable sedimentary source rock. The observations have been substantiated by microscopical data.

The basic rocks are interpreted to have undergone metasomatic changes involving introduction of microcline with the concomitant development of biotite, alteration of augite to hornblende-biotite and the development of sphene.

**49. A note on the occurrence of granite-porphyry near Dharwar, Bombay.**

R. V. JOSHI and R. V. THATTE, Dharwar.

During the geological mapping of the area around Dharwar an interesting formation was noticed near Arwathi, a village 13 miles west of the Dharwar town. It is an intrusion of granite-porphyry in the phyllites of the Dharwar age. The outcrop measures 10 ft. across and trends  $320^{\circ}$ , which is also the strike of the foliation of the adjoining phyllites. The rock is grey in colour and has a sp. gr. 2.64. In thin sections it shows the presence of phenocrysts chiefly of oligoclase and a few of potash feldspar and quartz. In a fine grained ground-mass consisting mostly of quartz grains, a few scales of white mica and one or two grains of zircon and apatite can also be seen in the micro-sections. The coarser grains of the minerals show feeble strain shadows.

This intrusion seems to be an apophysal form of the granite-gneiss occurring east of Dharwar and thus it is an important field evidence showing the relationship between the Dharwar and the granite-gneiss.

**50. Mineral Formation in Relation to Movement Episodes in the Metamorphosed Argillites and Arenites from Dhalbhum, Bihar.**

K. NAHA, Calcutta.

Detailed microstructural analysis of the metamorphosed argillites and arenites from Asanbani ( $22^{\circ} 42' 5''$  :  $86^{\circ} 19' 5''$ ) to north of Dhalbhumgarh ( $22^{\circ} 30' 5''$ ;  $86^{\circ} 33'$ ) has led to the following picture of mineral formation in relation to movement sequences.

Kyanite and staurolite show strong postcrystalline deformation with reference to thrusting, the deformation ranging from undulose extinction and intergranular rotation to intense intragranular flexure and slip, with the fabric of the included quartz trails in one folded staurolite unrollable. Staurolite is transformed to micas and chlorite, while kyanite changes to muscovite-sericite. Garnet shows syn- and



post-kinematic crystallization with respect to the main folding and development of schistosity, and postcrystalline rotation and fracture in relation to thrusting. Chloritoid in the chlorite-phyllites has formed during the puckering of schistosity with crystallization outlasting deformation, while chloritoid in the "Thrust Zone" shows syn- to post-kinematic crystallization with reference to the last impaired transport during thrusting. Muscovite, biotite and chlorite show postcrystalline deformation near local shears; in all other cases they occur in puckered tufts, with the individuals undeformed, often retaining the fold-fabric mimetically. Quartz occasionally shows intense postcrystalline deformation, but in general, quartz is late- to post-kinematic in relation to thrusting, with even the cataclasites in the thrust zone often blastomylonitic.

Thrusting thus seems to have taken place, after the peak of metamorphism, in the greenschist facies and perhaps locally albite-epidote amphibolite facies environments.

**51. Petrology of the so-called "Sakoli Mylonites, Cataclasites and Flaser Rocks" of Bhandara-Drug area, Madhya Pradesh.**

S. N. SARKAR, Kharagpur.

Rocks identified and mapped as "mylonites, cataclasites and flaser rocks of Sakoli age" by the previous worker in this area (topo sheets 64 C/7 and C/8) have been proved by the present author to be undoubted rhyolitic lava flows which unconformably overlie the Sakoli metamorphites and granite gneisses. The Rhyolite formation (less than 18,000 feet thick), which mainly includes non-porphyrific and porphyritic rhyolites, rhyolite porphyry, rhyolitic conglomerates, grits and tuffs, has undergone subsequent folding.

**52. A note on the Heavy Minerals of the Sandstones of the Iron-ore series around Jojohatu, Bihar.**

KRISHNA KANT SINGH, Kharagpur.

In the course of detailed geologic investigation of the chromite deposits and their associated ultrabasic rocks around Jojohatu, Bihar, the author has come across orthoquartzites, graywackes and subgraywackes interbedded with shales and slates of the Iron-Ore Series near the contacts of ultrabasic intrusives. A study of the heavy mineral assemblage of the sandstones has been presented in this note.

In order of decreasing frequency the following nonopaque heavy minerals have been identified :

Zircon (pink, colourless and pale brown), tourmaline (brown, violet and blue), glaucophane, staurolite, kyanite, hornblende, chlorite and spinel.

Zircons are well rounded and dusty, i.e. clouded with inclusions and are conspicuously abundant in some sandstones. Some tourmalines exhibit distinct violet colour (variety indicolite) and show authigenic growths on the prism. The presence of chlorite as an aureole around central core of magnetite is noteworthy.

The heavy mineral suite distinctly points to a dual provenance for the sandstones consisting of reworked older sediments and high grade metamorphic rocks.

The entire absence of garnet, an otherwise ubiquitous species in sediments, derived from metamorphic zones and the abundance of zircons in certain horizons, are some of the interesting features which may be of correlative importance.

**53. A Note on the Occurrence of Amphibolite and Dunite Association at Dodkanya, Mysore.**

S. N. WAKHALOO, Patna.

The account is given in the paper of the petrography and mode of occurrence of garnetiferous amphibolites which occur as minor associates of the highly altered intrusive dunite, the outcrop of which is in the form of a ridge with its summit from 50 feet to 75 feet above the surrounding country side. The amphibolites are more or less widely distributed, but are of restricted size sometimes taking the form of narrow dykes ranging from less than a foot to 5 feet in width. The excavations which have been made from time to time for winning magnesite, also reveal schlieren of amphibolites blending into the ultrabasic rock by gradual change in character and without bringing in sharp contacts. Views have been put forth that the amphibolites have resulted from the retrogressive metamorphism, in the amphibolite facies, of what might have originally been gabbro and pyroxenite differentiates of a magma of normal dunite composition. These fractions might have remained liquid long enough after the consolidation of the main dunite mass so as to form dykes, bars lenses and schlieren in it.

In regard to the nature of the amphibolites, there are two main types: (1) with plagioclase feldspar in abundance and (2) without any trace of feldspar. The latter type has evidently formed from ultrabasic rock of pyroxenite composition. Both the types contain garnet.

An account about the petrography of dunites and of the mode of magnesite occurrences in these is also given.

(v) Economic Geology

**54. A Phase Exchange Process for the Concentration of Brannerite from low grade ores.**

R. KRISHNASWAMY, Bombay.

Applicability of the "phase exchange" process for the concentration of brannerite (a uranium-titanium mineral) from low grade ores was studied. Oleic acid was found to have a marked influence on both the grade and the recovery of brannerite. The process, with kerosine and water as the two immiscible liquid phases, and oleic acid as the collector, was found to yield a better concentrate of brannerite than flotation or other methods.

**55. Isolation and Identification of Primary Radioactive Mineral occurring in the Copper belt at Mosaboni.**

DHARMA VEER BHATNAGAR, Bombay.

A primary radioactive mineral containing 76.1%  $U_3O_8$  has been isolated from the plant tailings of the Indian Copper Corporation which processes copper ore from Mosaboni mines in the Singhbhum District of Bihar.

Several ore dressing operations such as tabling, flotation, magnetic separation and super-panning were employed for the separation of a few grams of about 99% pure radioactive mineral from several hundredweights of the plant tailings. The purity of the isolated sample was checked with the help of autoradiographs.

On the basis of chemical analysis, X-ray and autoradiographic studies, physical and leaching characteristics, the mineral has been identified as uraninite or pitchblende.

The uranium mineralisation seems to have occurred in the Archaean era.

#### 56. Geophysical Investigations in parts of East and West Godavari Districts.

B. SUNDARA RAMA RAO, Waltair.

At the instance of the Andhra Government which granted a sum of Rs. 14,000 to the Andhra University for the investigation of the possible occurrence of lignite in parts of East and West Godavari districts, the present Geophysical survey using the electrical resistivity method was undertaken by the members of the Geophysics department. Most of the areas investigated were giving off more or less continuous supplies of natural gas, mainly methane. The present investigation deals with the results obtained by using the expanding electrode survey at several selected areas. An attempt was also made to interpret the results obtained in terms of the bore-hole data, wherever it was available. Some investigations were also made for the location of fresh water wells, which were highly satisfactory.

#### 57. On the occurrence of a Magnetite deposit in Barabar Pahar, Gaya, Bihar.

K. L. DAS, Howrah.

The deposit occurs in a very accessible area and is only seven miles away from the Railway Station, Bela, on the Gaya-Fatna section of the Eastern Railway. There is a good fair weather road from the Station upto the deposit. The mineral occurs as segregated masses of considerable size. In one occurrence it is more than 1,500 ft. long and 250 ft. to 300 ft. wide. One partially weathered sample from the surface was analysed and gave total iron as 63.89% and titanium oxide as 3.12%.

#### 58. Study of the Iron Ores of Jubbulpore.

V. S. DUBEY and UMA SHANKER, Banaras.

The Iron-ores of Jubbulpore district have been studied in great detail. They occur near the town of Sihora on the Central Railway between Katni and Jubbulpore and are situated within a radius of 15 miles from the Railway Station. The area is covered by Bijawar formations made up of phyllites, occasionally quartzites. Several hills in this area are found covered with soft laterite in which blocks of haematite are also found. The total area covered by this ore is not more than 2 or 3 square miles. Without detailed prospecting, it is difficult to calculate the amount of the ore present, but most probably the ore of good variety will not exceed 30 million tons. It is a residual kind of deposit formed by the removal of phyllite in which some fine layers of haematite are interbedded. Soft haematite in this area is utilized as a paint making material. A small amount of manganese is also associated with these iron ores and has been concentrated in the form of nodules on the surface. At a few places veins about 2 or 3 inches thick of manganese ore are also found. The origin of manganese is similar to that of iron except that in some cases it has been separated from iron and has produced pure manganese ore of lateritic variety. The ore is not in sufficient amount to warrant any big Iron industry. With the present price of iron-ore at Rs. 54 per ton F.O.B. at Vizag. port it can be economically exploited for export giving a profit

of Rs. 4 to Rs. 5 per ton. If cheap hydro-electric power can be developed this ore can be economically utilized for the manufacture of ferro-manganese.

**59. The Copper-ore deposits in Garimanipanta Area Nellore District and the structural control in their deposition.**

B. LASKAR, Calcutta.

Since the year 1800 when Heynes found the ancient workings in the Garimanipanta area, several attempts to locate mineralised veins, large enough to be economic have met with little success. Exploratory mining to shallow depths carried out during 1942-45, under the supervision of this author has revealed thin mineralised veins of quartz and pegmatite having a maximum lateral extension of 70 ft. and going down to a depth of about 60 ft. These veins and also others noted in the old workings, occur along the axial planes of tightly folded anticlines in hornblende schist derived from the metamorphism of basic sills in the country rocks. These folds are of isoclinal nature with dips varying from S.W. to the W. The anticlines are also pitching at varying angles and directions.

The country rocks here comprise granitised micaceous schists which are often garnetiferous. The strike of the country rocks varies from NW-SE to N-S, and the foliation dip varies generally from 25° to 60° in amount.

These mineralised veins send off irregular stingers along the shear joints in the adjoining body of the hornblende-schist and further into the country rocks mostly along their planes of foliation and rarely across the planes.

The primary cupriferous mineral chalcopryite is sparingly found. There are also aggregates of orthorhombic lamellar chalcocite probably derived from inversion of the isometric form. But the ore here consists mainly of oxidised masses and impregnations of supergene 'sooty' chalcocite, malachite, chrysocola, and a little azurite. The amount of supergene chalcocite increases near the water table.

**60. Observations on the Manganese Occurrences in the Kaladgi Basin, Bijapur District, Bombay State.**

A. M. MASCARENHAS, Londa.

The manganese occurrences in the Kaladgi Basin have been frequently referred to by previous observers who have remained rather dubious regarding the potentialities of the area. The possibility that the mineral exists in economic quantities is still entertained by speculators. The author has carried out a detailed field survey of a type locality 15 miles south-east of Kaladgi. In this area the manganese rock (Mn 44%) was seen to occur in three different ways: (a) As impregnations in the horizontal Upper Kaladgi limestone of insignificant thickness (1-12 ft.) and patchy distribution. The manganese is confined to an area of about 200 sq. ft. and probably occurs as a minor lens in the limestone. (b) As pocket concentrations in a secondary laterite which hardly has a thickness of 40 ft. The manganiferous portions of the outcrop hardly exceeds 50' x 50'. Sizeable manganese boulders are found only within the first 3 ft. from the surface. (c) As smooth rounded nodules scattered in one half acre portion of a field bordering the Bijapur-Hubli highway, it is possible that these nodules have reached their present locale accidentally in the form of road metal at the time of construction of the highway. A more likely possibility is that these nodules represent residual portions of the underlying manganese rock now brought to the surface by cultivation over scores of years.

From all considerations it seems that there does not exist any possibilities for the economic development of manganese in the Kaladgi Basin.

**61. Occurrences of Sillimanite in parts of Vizagapatam District, Andhra.**

C. NARASIMHARAO and S. V. L. NARAYANARAO, Kharagpur.

Sillimanite is one of the best known refractories which is used either in the natural form or in the form of bricks. Apart from its occurrence in Garo and Khasi hills of Assam, sillimanite is restricted in its presence to certain highly metamorphosed Archaean gneisses, wherein concentrated aggregates of the mineral have not been reported previously.

The note describes the occurrence of sillimanite in fair concentrates in two localities in the Eastern Ghats of Vizagapatam district, Andhra : near Tallapalem ( $17^{\circ} 38' : 82^{\circ} 53'$ ) and Relli ( $17^{\circ} 53' 30'' : 83^{\circ} 14'$ ).

In the former locality the sillimanite rock constitutes a hillock in the western limb of an eroded syncline whose axis plunges to the south. In both the localities the mineral occurs in bundles and needles associated with quartz and constitutes nearly 30% to 60% of the parent rock.

Experiments have been carried out with a fair amount of success to beneficiate sillimanite by means of froth floatation, using various frothers. It is concluded that sillimanite is amenable to froth floatation in the particle size range 0.177-0.068 mm. with turpentine or pine oil as frothers.

**62. A Note on the occurrence of Copper Ore near Gola, Hazaribagh District, Bihar.**

H. SEN, Calcutta.

The copper-bearing minerals chalcocite and malachite were discovered in January, 1943 in two exposures of anthophyllite-schist near Gola P.O. ( $23^{\circ} 32' 30'' : 85^{\circ} 43'$ ). The occurrence was examined again in June last year. The copper minerals occur as thin films over radiating crystals of anthophyllite. The rock contains 1.39 to 1.34 per cent copper, but the exposure is too small to be of any economic value. Presence of minerals like pyrite, pyrrhotite and chalcopyrite has been noted in runs of hornblende-schist a few miles on the east-south-east. A fault rock occurs on the west-north-west. It is suggested that sulphide mineralisation took place along a WNW-ESE belt of country occupied by basic and ultra-basic igneous rock enclosed in granite. The source of the sulphide is unknown.

**63. A Note on the Origin of Magnetite Deposits of the Auranga-Koel-valley, Palamau, Bihar.**

RAGHUJI VERMA Ranchi.

Ores of magnetite are found to occur at several places in the Auranga-Koel-Valley near Daltonganj in Palamau district. These occurrences have been carefully studied by the author with a view to arriving at an idea about their origin. Study of field relations of rock types reveals that these ores are genetically related to gabbroid (norites) and ultrabasic rocks which are intrusive into pre-cambrian tremolite schists and associated dolomitic marbles. The presence of magnetite in all the igneous rocks associated with these deposits and the intimate association of magnetite, pleonaste and Mg-Spinel in hypersthénites which invariably occur with these deposits support this view. This is further corroborated by the irregular shapes of deposits and their erratic distribution.

The principal ore occurrences are at (i) Gore ( $23^{\circ} 38' : 83^{\circ} 58'$ ), (ii) Datam ( $23^{\circ} 57' : 84^{\circ} 2'$ ), (iii) Biwabathan ( $23^{\circ} 55' : 84^{\circ} 3'$ ), (iv) Sua ( $24^{\circ} 0' : 84^{\circ} 6'$ ), and (v) Bhaurag-

wakhar (23.52' : 84.4'). Of all the deposits, Gore is the largest deposit. All these deposits are of analogous geologic character and of similar origin.

The similarity of these deposits, in their general mode of origin though differing in detail, to others in various parts of the world and in this country such as at Taberg in southern Sweden and Fkersund-Soggendal district in Norway and also of Singhbhum district in Bihar which are regarded as deposits due to magmatic differentiation strongly suggest that these deposits also belong to this class and not to hydrothermal solutions emanating from the residual basic magmas which gave rise to dolerite intrusion as has been pointed out by Wakhaloo.

#### (vi) Groundwater

#### 64. A Preliminary Note on the Groundwater conditions in the Ghar area of Saharanpur District, U.P.

F. AHMAD, Calcutta.

Groundwater investigations in an area of over 100 sq. miles along the northern edge of the Gangetic Plain in the Ghar area of Saharanpur district, U.P. indicate that the slope of the water-table is generally northwards, towards the Siwalik hills, almost directly opposite to the topographic slope. This is typical of the Ganga valley recharge area. An intensive study of available data on subsurface conditions was made.

It appears that the area is underlain by two extensive aquifers separated by an impermeable bed of clay, except in a narrow belt parallel and adjacent to the base of the hills, where the two are effectively joined. It further appears that the transmissibility of the lower (? artesian) aquifer is appreciable, and that its regional groundwater flow southward, away from the base of the Siwalik hills, is sufficient to lower the water-table in the belt of interconnection, causing a 'line sink' in the water-table there. As a consequence, the water-table aquifer in the area is being drained into this 'line sink', hence its northward gradient. Recharge of the water-table aquifer by precipitation in the outcrop area is sufficient to replenish its losses to the underlying (?) artesian aquifer in the belt of the interconnection, and thus the regional northward slope of the water-table is maintained.

It may be inferred from these conditions that the underlying (?) artesian aquifer is a promising source of water supply for future development.

#### 65. A Note on the Hydrological Conditions in the Tarai Districts of Eastern Uttar Pradesh.

F. AHMAD and K. V. RAGHAVA RAO, Calcutta.

An area of nearly 600 square miles in the districts of Gonda, Bahraich, Basti and Gorakhpur in eastern Uttar Pradesh, mostly in the Tarai belt, between latitudes 26°05' and 28°24' and longitudes 81°03' and 84°26' was studied during 1954-55 with a view to assess the groundwater potentialities of the area.

The studies included : (a) a detailed inventory of the open-wells and tube-wells of the area, (b) preparation of water-table and depth to water maps to show from the former, the source, movement and discharge of groundwater and (c) collection of well log data of completed State owned tube-wells.

The intake area of the region lies in the northern part along the foot-hills of the Himalayas. The general movement of groundwater is towards the south and south-east. The water-table in this extensive area varies considerably from

one part to another, but it may be generally stated that it is nearer to the surface in the southern part of the tract and lowers considerably as the submontane region is approached.

In the Gonda area, the maximum discharge recorded from the tube-wells was 650 gallons per minute, the minimum being 360 gallons per minute. The diameter of the tube-wells near the top is 12 inches and the wells are fitted with 15 M.P. centrifugal pumps. The average percentage of clay in the strata is 24, the rest being fine to medium sand. The maximum depth drilled in the area is 333 feet below groundlevel. In 57% of the open-wells the waterlevel lies less than ten feet below the groundlevel and in none does the depth exceed 17 feet, the maximum depth recorded being only 16.77 feet. In this region the surface clay zone does not exceed the depth of 20 feet below groundlevel and the top aquifer lying just below is nearly 45 feet in thickness. The highly promising second aquifer, the main source for the existing tube-wells, lies about 120 feet below the surface.

In the Balarampur area where tubewells have been in existence since the 1930's, the life span of a tube-well is estimated to be 15 to 20 years.

In the Basti area the depth to water-level varies from 18.17' to 7.05' below land surface. In the Harriaya division some of the strata sections pierced by tube-wells show a greater percentage of clay than sand, but even there considerable groundwater development has been possible; because good aquifers of considerable thickness are met with in the bore-holes. The maximum depth to water-level in the open-wells measured was about 16.00 feet below the land surface.

In the Khalilabad division the discharge of tube-wells range from 450 to 560 gallons per minute. The depth to waterlevel in the open-wells, lie within the 11-20 feet range.

In the Nanpara region the tubewells had, then not been energised. The water-table map of the area investigated around Nanpara, was prepared. The movement of groundwater is found to be towards south and south-west, though the surface drainage runs generally to south and south-east. The gradient of the water-table is steep in the north and north-western parts of the area. The groundwater finds an escape into the Sarju *nala*. The water-table is lowest in this area compared to the entire region surveyed. The depth to water in most of the wells, falls in the range 21-30 feet below land surface. In some of the dug wells the water-level exceeds 31' in depth below ground-level.

The cultivable commended area for each tube-well is averaged to 1,000 acres, in all the areas canvassed for tube-wells.

It is concluded from the inventory of the dug-wells around Tulsipur town that (a) an artesian basin may be found in the Tulsipur-Pachparwa area and (b) the opinion that the entire trans-Rapti area in Gonda District is unsuitable for tube-well development has no scientific basis.

#### 66. A Note on the Flowing Wells in the Neyveli area, South Arcot District, Madras.

SANATKUMAR BASU and ATANU GOSWAMI, Calcutta.

The flowing well area described in this paper covers about 100 square miles, south of Neyveli ( $11^{\circ} 32'$ ;  $79^{\circ} 29'$ ; 58M/6) within latitudes  $11^{\circ} 22'(\text{N})$  and  $11^{\circ} 32'(\text{N})$  and longitudes  $79^{\circ} 23'(\text{E})$  and  $79^{\circ} 33'(\text{E})$ .

The discharge rates of flowing wells with casings 4 to 6 inches in diameter ranged from about 20 to 690 gallons per minute, and their jets varied from 0.35 to 12.15 inches above the tops of casings. The temperature of water of the wells measured ranged from  $88.5^{\circ}\text{F}$  to  $95^{\circ}\text{F}$ , and had a distinct relation to the depth of the aquifer tapped. The closed-in pressures ranged between 1.8 and 38.5 feet above the land surface (55.6 and 93.6 feet above mean sea level) in those wells



which tap aquifers between depths of about 230 and 570 feet below land surface. This indicates that the 94 feet topographic contour delimits the flowing well area from the non-flowing well area. The pressures were found to increase generally in a south-easterly direction; and this feature corresponds with the topographic slope of about 25 feet per mile in the same direction.

The total discharge rate of wells inventoried was estimated at 7,800 gallons per minute before the monsoon, in May, 1956, in contrast to a total rate of 8,700 gallons per minute during the monsoon, in October and November, 1955. This increase of about 10 per cent in the total discharge may be attributed to monsoon precipitation and the resultant rise of water level in the recharge area.

The aquifer immediately underlying the lignite in the vicinity of the pilot quarry appears to correlate with that tapped in the flowing well area, and was found to extend continuously beneath an area of more than 100 square miles. This continuity over a large area is of vital importance in as much as the mining of lignite is concerned. The mean pressure gradient of this aquifer was computed to be about 1 in 1,000 in a south-south-east direction. The isothermal map of the same aquifer showed that the temperature of water in these wells increases by 1°F in a distance of 5,000 feet towards the south-east, in conformity with the direction of dips of the formations.

#### 67. Notes on the Geology and Groundwater conditions of certain parts of the Darrang and Kamrup Districts of Assam.

G. C. CHATERJI and K. N. PRASAD, Calcutta.

The results of the geohydrological observations carried out in parts of the Darrang and Kamrup districts of Assam, during the season 1954-55, are embodied in this paper. The area surveyed lies between latitudes  $26^{\circ} 0' : 27^{\circ} 0'$  longitudes  $90^{\circ} 52' 30'' : 92^{\circ} 46' 30''$  in the survey of India sheet No. N.G.46 and approximately 2,000 square miles in extent.

The work consisted essentially in determining the groundwater potentialities of the valley north of the Brahmaputra, in Darrang and Kamrup districts, with special emphasis on regional hydrology. Studies on the Quaternary formations, the 'Bhabar' and the 'Tarai' deposits, the source and movement of groundwater, the spring line and the terraces which have a significant bearing on the groundwater conditions have been discussed. Relevant hydrological data comprising depth to water, and hydraulic gradients, were also collected from the inventory of more than 150 open-wells located in the area.

From the base of the Himalayas there is a gradual slope of the 'Bhabar' and 'Tarai' belts towards the Brahmaputra alluvium. The 'Bhabar' belt consists of integrated alluvial fans of Himalayan streams, and is underlain almost entirely by boulder, cobble, pebble, gravel and coarse sand. Occurrence of groundwater in the 'Bhabar' is comparatively deep. Down gradient the Bhabar belt merges imperceptibly with the 'Tarai' belt. The contact between the 'Bhabar' and the 'Tarai' is characterised by a zone of springs. A high water-table in the shallow aquifers and artesian conditions in the deeper aquifers are significant features of the 'Tarai' belt. The 'Tarai' are probably underlain by intertongued coarse sand and pebbly gravel aquifers, with impervious, clays or silty-clays. In the axial alluvial fill of the Brahmaputra the water-table in the upper most aquifers are unconfined, but the deeper aquifers occur under confined but non-flowing conditions.

The position of the outcrops of crystalline rocks which form low hills bordering on the Brahmaputra river and their relationship with the axial stream have also been discussed. Between Silghat and Bhomoraguri, the Brahmaputra river



passes between the gneissic outcrops which rise 250 to 500 feet above the present flood plain of the river. An outlier occurs north of Singri ( $26^{\circ} 37' : 92^{\circ} 30'$ ).

A dissected alluvial terrace, about 20 feet high, from Singri through Borcholla, Dalgaon, Kharupatia, Mangaldoi and Rangunati to the hill sections near Kuruva was mapped. This probably marks the northern edge of the present Brahmaputra flood plain. Scattered bed-rock hills also occur north of the river, in Kuruva-Amingaon-North Gauhati where the river appears to be hung up on a bed-rock spur of the Shillong plateau. Similar conditions occur in the Goalpara district (Jogighopa), where there is an extensive tract of detached alluvium drowning the hills north of the Brahmaputra river. Thus the Brahmaputra now flows on a shelf of bed-rock whose highest projections form isolated hills, the basal portions of which are covered by alluvium. The Brahmaputra appears to have been shoved south by strong alluviation of the Himalayan streams. It is quite probable that the Brahmaputra river, flowed north of Bihata-Kuruva-Amingaon hills and the Singri-Tejpur outliers. It is, however, very unlikely that the river ever followed a course beyond the hills which lie about 15 to 20 miles north of Goalpara.

#### 68. Groundwater Control in the Neyveli Lignite Field, South Arcot District, Madras.

G. C. CHATERJI, V. SUBRAMANYAM and P. H. JONES, Calcutta.

Since 1949 the Geological Survey of India have repeatedly emphasized that the groundwater problem in the Neyveli Lignite field is the most important factor determining the feasibility of mining the lignite deposit. They suggested the drilling of 10 deep boreholes across the field to explore the structure and groundwater conditions.

Detailed groundwater investigations by the G. S. I. in the lignite field commenced in October, 1954 at the request of the Government of Madras and continued at Duffryn Technical Services, Ltd., London. During the period January to March, 1955, on the basis of a few logs of 400'-deep wells drilled late in 1954, the G. S. I. recommended, with plans, single-pump tests individually in the first and second aquifers below the lignite, to determine the hydraulic characteristics of these aquifers. A test of this type was carried out in two existing wells tapping the second aquifer, and a report thereon was submitted in April, 1955. No test was made of the first aquifer at that time.

Even after the above tests were conducted by the G. S. I., the consultants recommended that the Lignite Investigations Department drill and complete 20 pump wells and 30 observation wells in the area about 2 furlongs north of the Pilot Quarry for lignite, to demonstrate whether or not the pressure of the artesian water could be depressed 20 feet below the base of lignite, as would be required under mining conditions. Drilling and construction of these wells, costing nearly  $1\frac{1}{2}$  Crores of rupees, was completed in December, 1955.

The large scale "demonstration" test with 20 pumps, conducted during February and March, 1956, did not accomplish the required drawdown of water level, and the Lignite Authorities then requested the G. S. I. to complete the pumpage required to effect the same. The G. S. I. computations based mainly on the results of their April, 1955 tests showed that a pumping rate of 27,500 g.p.m. for 30 days would be required to effect the desired drawdown, and a rate of 25,000 g.p.m. would maintain it at that level thereafter. To achieve this, the Lignite Authorities, who suspended further tests on the advice of the G. S. I., although the consultants desired continuation. On the basis of these results the practicability of controlling the groundwater by pumping was established. On the strength of these findings the L. P. C. C. sanctioned the mining phase of Neyveli Lignite Project.

During the demonstration test several wells failed by sanding, on account of improper screening and gravel packing. Realizing the importance of dependable and effective wells during the mining phase of the project, the Lignite Authorities have endorsed an experimental programme of well construction using several types of screens and gravel pack, to be conducted under the guidance of the G. S. I.

After detailed study of the subsurface geology of the aquifers underlying the lignite the Geological Survey of India have recommended an investigation of the feasibility of chemical grouting for groundwater control, as this method appears to be less expensive than the heavy pumping method and would insure against bursting of the mine floor by artesian water, which could occur as a consequence of power failures if the latter method of groundwater control is adopted. The project has agreed to make the necessary tests of the chemical grouting technique.

#### **69. Groundwater Exploration in the Narmada Valley, Madhya Pradesh and Bhopal.**

A. K. ROY, Calcutta.

In the Narmada Valley, one of the sixteen areas selected under the All-India Groundwater Exploration Programme, exploratory drilling of 44 boreholes was done during the period January, 1955—May, 1956. Pre-drilling geological and hydrological data collections, however, started in 1953. Post-drilling observations are continuing.

The alluvial material in the Narmada Valley covering an area of about 5,000 square miles is the principal geological formation which was explored for possibilities of groundwater development. The sites for drilling the exploratory boreholes were selected mainly on geological consideration, *i.e.*, in places where it was anticipated that alluvial fill would be considerably thick. Geophysical depth probing was done around each selected site to ascertain the probable thickness of the alluvium.

Five drilling rigs and ancillary testing equipment were available for exploration.

An aggregate thickness of about 21000 feet were drilled by the 44 holes. Of these 16 were converted into production wells; 7 more could be finished as production wells, but were not completed as such due to other considerations. 27 out of 44 holes reached hard basement rock. The depth of the individual holes varied between 79 and 1056 feet below land surface. Drill cuttings were examined constantly during the progress of drilling and samples were collected at every 10 feet or at formation breaks. Electrical logs of the boreholes were recorded. From these studies of the drill cuttings and interpretation of the electrical logs strata charts of the boreholes were prepared. Mechanical analyses of the granular samples were done to determine the size of the screens to be used in the tubewell assemblies and the size of gravel to be used for shrouding the wells. When aquifer materials likely to yield considerable quantities of water were present the hole was converted to an exploratory-cum-production well. Development of the wells were done by surging with compressed air. Final aquifer performance tests were conducted with deep-well turbine pumps. During this test data pertaining to static water-level, drawdown, discharge and recuperation were collected. Specific capacity of the wells and permeability of the aquifers tapped were computed from the above data.

In the Narmada Valley specific capacity of the wells completed varied between 9 and 59 gallons per foot of drawdown. Permeability of the aquifers ranged from 500 to 2400 gallons per day per square foot.

Evaluating the result of the exploration five blocks have been delineated, four in Madhya Pradesh and one in Bhopal. These five areas represent an aggregate of about 560,000 acres to the north of the Narmada river and about 220,000 acres to the south of the river. Groundwater can be developed economically in these blocks for irrigation and other purposes.

#### **70. On the Water Supply of Jabalpur area, Madhya Pradesh.**

A. K. ROY and S. K. GUHA, Calcutta.

The paper deals with an evaluation of both surface-water and groundwater resources of Jabalpur area, Madhya Pradesh, with particular reference to the city's water supply requirements. In recent years Jabalpur has developed rapidly and further expansion of the city and its suburbs is contemplated arising out of the recent decision regarding the reorganisation of States. The ultimate requirement of the city's water-supply is estimated at 7.5 million gallons per day (3 million gallons in addition to present supply) providing a per capita rate of 25 gallons. Bulk of the existing supply comes from two reservoirs, viz. (1) Jabalpur Water Works Reservoir (gravitational supply) and (2) the Pariat Water Supply (Pumping Scheme) located about 4 miles east and 15 miles ENE of the town respectively. The supply from these reservoirs, however, is subject to the vagaries of monsoon precipitation. In addition to these, there are a number of 8-10 inch diameter tubewells varying in depth between 150 and 300 ft., in the Pachpedi and Gun Carriage Factory areas which cater partially to the needs of the Cantonment area.

Both groundwater and surface-water conditions of the area have been studied in detail and schemes have been put forward to exploit these sources to meet the increased demand.

As a surface source, it has been suggested to tap the Narmada river which flows five miles south of the town, and has a recorded minimum discharge of 30 cusecs during the dry season. However, the scheme for supply by pumpage from the river will entail the construction of sedimentation-tanks, filter beds, etc., and may prove expensive.

Alternatively, it is suggested to sink a number of tubewells (to a maximum depth of 300 ft. with 10-inch casing) in the alluvium of Bheraghat-Shahpura region, west of the town. Recently, two exploratory boreholes were drilled in this area by the Exploratory Tubewells Organisation under the Indo-U. S. Operational Agreement No. 12; and in these holes 95 feet and 130 feet thick zones of aquifer have been recorded. On test the well at Shahpura, gave a discharge of nearly 38000 gallons per hour, with a drawdown of nearly 14 ft. So it is expected that 4 or 5 tubewells will be sufficient to meet the extra need of 3 million gallons a day, assuring a direct supply of clear water.

#### **71. A Note on the Relationship of Water-table to Precipitation and Evaporation in an Observation Well, near Hoshangabad, Madhya Pradesh.**

A. K. ROY, V. C. JACOB and S. BASU, Calcutta.

The daily fluctuations of the water-table in response to rainfall and evaporation were studied during 1955-56 from a hydrograph obtained by installing an automatic water-level recorder, on an unused well in the Government Agricultural Farm near Hoshangabad, Madhya Pradesh.

The studies indicate that the water-table in the area under investigation fluctuates directly in response to infiltration from rainfall and to evaporation. The

water-table shows a steady decline from early October to mid-June. The maximum depth to water at the close of the dry season (15-6-1955) is 27.5 feet below measuring point (M.P.) which is about 2.5 feet above land surface. The minimum depth in the rainy season (31-8-1955) is only 9.9 feet below M.P. The daily fluctuation of the water-level is of the order of 0.01 to 2.6 feet. Some small deflections in the hydrograph are attributed to the diurnal changes in the atmospheric pressure. Graphs showing the correlation of daily fluctuations of water-level with daily evaporation and precipitation have been prepared.

**72. Some Geohydrological Observations on a deep tube well at South Sinthee Road, Calcutta.**

A. K. ROY and K. N. PRASAD, Calcutta.

The paper embodies certain geohydrological observations on a 12 inch deep-tube well recently drilled at South Sinthee Road, Calcutta. Besides formation logging of the borehole, details on the aquifer characteristics, screen settings, yield figures, drawdown and transmissibility were determined. These have been briefly discussed in the paper.

Aquifer zones from 252 to 277 and 320 to 392 feet with a total thickness of 97 feet, have been suggested for screen settings. Based on the pumping test, co-efficient of transmissibility is determined at 626000 g.p.d/ ft., and permeability at 6450 gallons per day per square foot. Further, from the results of the aquifer performance test, it is concluded that large yields of water (more than 3 cusecs) could be expected by installing a deep-well turbine pump with a reasonable drawdown of 8-10 feet.

The quality of water based on the chemical analyses indicate that by itself the water is unsuitable either for domestic, industrial or for irrigation purposes. The total dissolved solids are of the order of 1300 parts per million. The presence of excessive iron (more than 0.55 p.p.m.) and the high hardness of water, indicate that the water should be treated previously for domestic and industrial purposes. Blending 3 parts of filtered water (existing Corporation supply) from the Hooghly, with one volume of tube well water is likely to lessen the chloride content and make it fit for domestic consumption.

**73. Near surface groundwater conditions in the Piparia-Narsinghpur Region Narmada Valley.**

A. K. ROY and D. V. RAMANAMURTY, Calcutta.

The Piparia-Narsinghpur region lies in the Hoshangabad and Raisen districts of Madhya Pradesh and Bhopal State respectively and forms the central part of Narmada valley. The present investigations were carried out during the field season 1955-56 of the Geological Survey of India. Altogether 368 open-wells widely distributed all over the region, covering an area of about 1500 square miles, were inventoried with a view to 1) study the occurrence and disposal of groundwater in its relation to geology 2) study the quality and quantity of the water available from the wells for irrigation, domestic and public water-supply purposes and 3) prepare the groundwater contour map of the region.

The Vindhyan and Satpura mountains border the northern and southern sides of the area respectively. The rock-types constituting these hill ranges belong to Archaean, Bijawar, Gondwana, Lameta and Deccan Trap formations. Almost all the wells inventoried lie in the alluvium with depths ranging down to 75 feet. The alluvium in the shallow zone contains only sand mixed with clay.

The average annual rainfall in this region is about 51 inches and is the main source of groundwater in this area.

The groundwater contour map, the chloride, bicarbonate and hardness of water maps, were prepared. The depth to water below land-surface ranges between 0.2 feet and 75 feet. From the groundwater contour map it can be perceived that the water-table slopes towards the Narmada river from the hilly regions on either side. The gradient of the water-table is about 7 feet per mile on the southern side and 10 feet per mile on the northern side of the Narmada river.

The chloride content of the water-samples ranges between 10 ppm. and 1217 ppm., the bicarbonate content between 47 ppm. and 850 ppm. and the hardness between 43 ppm. and 2500 ppm. About 89 percent of the water samples analysed show a chloride content less than 200 ppm., 61 percent show a bicarbonate content less than 500 ppm. and 75 percent show a hardness less than 500 ppm. In general the water is suitable for drinking and irrigational purposes. About 97 percent of the water samples has hardness more than 200 ppm. As low hardness is desired for domestic purposes, other than drinking, the water samples do not seem to satisfy the requirement. The water samples have pH values of more than 7 which indicates that they are of alkaline nature.

#### **74. Electrical Logging for Groundwater Exploration in the Sonapat-Panipat area, Punjab (I).**

S. C. SINHA, Calcutta.

The primary purpose of electrical logging of uncased mud-filled boreholes is the identification of the geological formations traversed of the fluids which some of the formations contain. Electrical logging measures two electrical properties of the sub-surface formations, resistivity and self-potential. Supplementary information regarding the characteristics of the geological formations of the area under investigation are also necessary to make a complete analysis of the electric logs.

An electric logger, the type used by the Geological Survey of India, has two electrodes of which one is kept on the ground in the mud pit and the other allowed to traverse the borehole. 110 volts-60 cycles current is passed through the two electrodes. The mobile electrode, while traversing the borehole, picks up the two electrical properties mentioned above and conveys the same to the instrument through the cable that carries it. The signals undergo a series of rectification, conversion and amplification and finally are recorded by a pen on a moving calibrated chart.

In 1954-55, a groundwater survey was undertaken in the Sonapat-Panipat area of Punjab (I) when a State Government Project of drilling a large number of irrigation tubewells was in progress. The survey comprised groundwater inventory including a canvass of open-wells and tubewells, study of drill cuttings and electrical logging of boreholes, chemical analyses of water-samples, performance of pumping tests. The area covered was about 120 square miles. Open wells varying in depth between 15 and 33 feet used for small scale irrigation purpose, yield about 1,200 to 1,500 gallons of water per hour in a work day of 10 to 12 hours. The newly constructed tubewells, 27 inches in diameter and 350 to 400 feet in depth yield on the other hand, about 40,000 to 45,000 gallons of water per hour.

The paper presents two geological sections drawn on the basis of the study of electrical logs and drill cuttings of boreholes. These show the locations for the major water bearing formations, indicating also the quality of water contained therein. Because of the characteristic electrical properties of the geological strata encountered by the logging electrode even 2 to 3 feet thick 'marker beds' were

recorded. This is not usually possible with drill cuttings collected from the circulating drilling fluid.

**75. A note on the Hydrological conditions around Jamnagar, Saurashtra.**

R. SURULINATHAN, Calcutta.

The hydrological conditions of the area around Jamnagar were studied in June 1956. The average rainfall of the area is 19.2 inches. An analysis of the rainfall data covering a period of 55 years shows that the precipitation tends to be cyclic with the average length of the main periods of decline being 1.9 years. The rainfall is erratic. Years of serious failure are frequent. But the rainfall is well distributed within the rainy season. The average frequency of rainfall below half the mean is 1 in 3.4.

The water-table in this region generally rests 16 to 20 feet below groundlevel. All the open wells in this area are located on trap. Basalts and dolerites are the common rock types. The traps are traversed by innumerable joints running in all directions; these form excellent conduits for the flow of underground water. The groundwater available per sq. mile is calculated to be 89.6 million gallons. Some open-wells are known to yield as much as three lakh gallons of water per day in 16 hours of pumping.

The geology of the area precludes the possibility of extracting groundwater through tubewells. It is estimated that large diameter open-wells sunk in this area will yield moderate quantities of water to meet the local requirements.

The chemical quality of the water from the open-wells is good for domestic, irrigational and other purposes. Water is slightly alkaline and hard; the chloride content varies from 60 to 236 ppm., bicarbonate 74 to 439 ppm. and sulphate 5 to 36 ppm.

## B. GEOGRAPHY

### (i) Geomorphology

**76. The Kalighai-Barchouka Basin.**

KANANGOPAL BAGCHI, Calcutta.

The paper deals with the hydrographic characters of a region enclosed by the two streams, the Kasai and the Subarnarekha. The area presents some interesting fluvial hydrographic features that merit recognition by students of geomorphology. It is a region where the rivers are carrying on their normal fluvial functions at youth, maturity and old age in succession. It is also an area where the rivers have their outfall into a sea subject to tides and periodic influence of the winds. The sea level fluctuates considerably, involving the outfall points and profoundly affecting the hydrographic characteristics of the rivers. It is also the area where, man, in a frantic effort to combat the vagaries of the rivers, has undertaken measures that have in the long run accentuated the problems that were intended to be tackled, thereby leaving a legacy quite intriguing for subsequent planners. The region referred to is the southernmost part of the Midnapore district, approximately south of the railway line of the Eastern Railway, connecting Kharagpur with Howrah.

**77. On the wind-gaps and water-gaps in the Dharwar rocks occurring around Dharwar (Bombay State).**

R. V. JOSHI and R. V. THATTE, Dharwar.

The paper gives an account of a preliminary study of the wind-gaps and water-gaps occurring in the ridges consisting of the Dharwars (banded haematite-quartzites, shales and phyllites). 67 wind-gaps and 15 water-gaps, excluding minor notches and cols are recorded from the map and the characteristic features, such as slopes of the valleys, of a few of them have been studied in the field. Wind-gaps are very common in quartzites and their frequency is great at 2250 ft. and 2100 ft. levels. Morphometric analysis of the area indicates the presence of two prominent levels—perhaps erosional levels—at about the same heights. The predominance of wind-gaps at these levels is significant and this may be taken as an additional evidence of former erosion cycles.

**(ii) Climatology**

**78. A note on the distribution of pressure and winds in Madhya Pradesh.**

B. K. BIDVAI and B. G. TAMASKAR, Amravati.

An attempt has been made, in the paper, to correlate the distribution of pressure with temperature. A division of Madhya Pradesh into wind direction and wind velocity zones has been suggested, on the basis of a detailed study of the direction and velocity of the winds in Madhya Pradesh. Several anomalies in the distribution of temperature and pressure, and pressure and winds have been noted.

**79. Moisture Regions of Nigeria.**

P. K. SIRCAR, Delhi.

The various moisture regions of Nigeria, according to the scheme in the second classification of Thornthwaite (1948), have been delimited and compared with the vegetation regions mapped by Rosevear (1954). In the computation of the moisture indices for the 14 stations, for which mean monthly rainfall and temperature statistics are available, the potential evapo-transpiration for each has been calculated by using the Khosla formula (1950). It has been shown elsewhere (Sircar, 1953) that this formula gives more accurate results under tropical monsoon conditions of India, and a recent study (Jarrett, 1956) has also adopted the same modification for one area of Tropical Africa.

In general, the moisture regions mapped in this paper show broad resemblances to the Rosevear Vegetation Zones, but there are important discrepancies in detail. These have been discussed in the paper and suggestions have been put forward for further work on the problem.

**80. Water balance from Climatic Data.**

V. P. SUBRAHMANYAM, Waltair.

The climatic water balances of Port Blair and Sukkur were worked out according to the 1955 scheme of Thornthwaite. This scheme is different from his (Thornthwaite's) 1948 system, in that the moisture holding capacity of the soil

in the former has been taken to be 30 centimeters and that the utilization of this stored moisture was worked out according to a more rational procedure based on the actual physical laws governing the exchange of moisture between the soil and the atmosphere.

The graphical representation of these water balances was presented, showing clearly the periods and amounts of water surplus and water deficiency in different months of the year.

Analysis of this kind, based both on a monthly and daily balance, it is suggested, would be highly useful in agricultural operations like irrigation and crop scheduling.

### (iii) Economic Geography

#### 81. Rainfall rythm and Rice cultivation in Kerala.

V. A. JANAKI, Baroda.

The paper establishes the close relationship between rainfall and rice cultivation at every stage of its growth and how a slight increase or decrease in normal rainfall, or its occurrence out of season results in a bad harvest. The areas in the Palghat gap region like Walluvanad, Chittoor and Palghat bear two crops. On the other hand the taluks in North Malabar bear only one crop as they are shut off from the influence of the retreating monsoon. Graphs show the relationship between rice cultivation and rainfall. The five day normals have been used in place of the monthly average since they are the nearest equivalent of the fortnightly rainfall rhythm on which all cultivation in Kerala is based.

The first rice crop is sown about the third week of April. The seeds sprout in three weeks with the help of the slight showers that follow and they are ready for transplantation by the middle of May and the rice is harvested in August before the burst of rain during the retreating monsoon period. The field is then ploughed and the seed sown and transplanted in quick succession for the second crop. Transplanting takes place during the period of the retreating monsoon and the crop is harvested in January. The field is left fallow for the rest of the year or such crop as ginger, gram or vegetables may be grown.

Any slight deviation in the fortnightly rhythm of rainfall causes great harm to the crop. The paper or graphs prove that even in a region of "adequate rainfall" for rice cultivation there are hardships for the peasants which arise from untimely rainfall or lack of rainfall even if the monthly average or the yearly average appear to be sufficient.

The paper does not take into consideration irrigated rice or the special types of rice which are grown in the hills or in low-lying wet land where water is available throughout the year.

#### 82. Cane cultivation and its problems in the Saryupar Plain.

S. PANNU.

The Saryupar plain forms a part of the Ganga plain, comprising Gorakhpur, Deoria, Basti, Gonda and Bahraich districts of U.P. north of the Ghaghara.

The mainstay of the people is agriculture and about 71% of the total area is under cultivation. The non-food crops occupy only about 7% of the total cropped land. Sugarcane is the most important cash crop and occupies about 80% of the total area under non-food crops.

The highest intensity of cane-growth is found in the Deoria district covering about 43% of the total sugarcane acreage of the region. The climate and the



soil are both very favourable for its cultivation. It flourishes more in Bhat soil area (a kind of soil rich in lime). Irrigation, both ordinary and tubewell, is essential for a favourable crop.

The cane area has shown a gradual decline between 1900 and 1914, but thereafter it has increased considerably, above its peak in 1938 as influenced by tariff protection granted to the Sugar Industry in 1932.

Ratooning is the cheap practice and nearly 50% of the standing cane is ratoon, especially in Bhat land. It is followed due to relative lower cost of production. But the yield per acre in this case is much lower than that of fresh cane.

It may be remarked that the cane cultivation is very enervating and the yield has been continuously falling in both Bhat and Bangar areas.

The indigeous canes were resistant to several pests and diseases. The introduction of improved canes, which are more susceptible to pests and diseases, has created more complications.

Cultivation of cane has brought in considerable changes in the pattern and practice of Agriculture. Soils are losing their fertility and the yield is falling. But the Sugar Industry has expanded much with the increase in cane acreage.

### 83. Geomorphic features of Saffron cultivation and its future in Pampur Karewa (Kashmir).

A. N. RAINA, Srinagar.

Despite its non-nutritious character, saffron (*Crocus Sativus*), *Zāfrān*, is prized as a bouquet, condiment and a pigment. Its cultivation is restricted to the east of the Jhelum which flows 150 feet below a flat-topped plateau composed of alluvial or lacustrine material. The total area under Saffron cultivation at Pampur village (Kashmir Valley) is 20,000 Kanals. For the successful cultivation of Saffron the ground is thoroughly cleared but plough is used and with the help of sticks, the soil is beaten and dug out. Clay is spread over the plots to give these small plots a concave shape. Narrow ditches surround these plots to divert drainage. By the end of July, soil is ready and in October blossoms appear and look like a swarm of green reeds, the strength of which depends on timely rain. In winter rain and snow give strength to the soil-bed, and in early spring (March-May) grass is allowed to grow and then furrowed in, to serve the purpose of green manuring. No speciality was revealed when the soil was put to chemical examination. It is experienced that draught prolongs the blossoming days while humidity shortens these. Cool breeze from the river strengthens the plant. The red orange tip of the plant is the *Shah-i-Zafrān*, (The Imperial Saffron). The sundried flowers are beaten with sticks and winnowed carefully.

### 84. Is Orissa overpopulated?

BICHITRANANDA SINHA, Calcutta.

The official conclusion is 'Orissa can not be regarded as over populated at all' and can carry more men, but our conclusion is 'Orissa is over populated and will continue to be over populated'. Here is an explanation for this.

The density of population in Orissa may be lower than that of many of the Indian States and even lower than that of the Indian average but the optimum carrying capacity of land has not only reached its zenith but has also overflowed its capacity. Orissa is maintaining 286,658 extra agricultural labourers and as a consequence the living standard has become deteriorated and is the

lowest in India. About 72% of the existing holdings are not only uneconomic but only account for about 25% of the cultivated area.

The present dietary structure and its standards are appalling and the calorific value of per capita consumption unit of agricultural labourer is only 2215 which is less than that of the Indian average and suffers from 26.0% deficiency. There is not only dearth of quantitative value but from the optimum point of requirement of a balanced diet the entire income of the agricultural labourer is spent within 6 to 8 months.

The per capita 'net sown area' has not only fallen from 1.16 acres in 1921 to 0.83 acres in 1951 but also the man-yield ratio has declined in 'superior cereal' groups. The impact of the First Five Year Plan is not very encouraging as even today our living standard is even lower than that of 1932-41.

If per 'acre-unit' be taken as the criterion for judging the efficiency of land we have to provide employment for 7,556,000 agricultural men who are in excess of the lands optimum requirements in some other sector. Thus Orissa is over populated and if the present rate of reproduction is not halted it will continue to be over populated. Orissa may not be able to solve the problem even after developing all her available resources according to the present state of scientific knowledge and technological advancement.

#### **85. Population Growth in Howrah City.**

A. B. CHATTERJEE, Calcutta.

Howrah City like Calcutta has no ancient historical background. No authentic record of its population prior to 1872 is available. The population increase is very high during the last 80 years mainly due to the increasing industrial importance of the city. In some particular wards the increase is particularly well-marked. Density is high in the wards which have got a large number of industries and a centrifugal trend in the movement of population within the limits of the city is noted. The growth compared with other cities in the Lower Hooghly Region is found to be similar. Death rate is generally higher than the birth rate in most of the wards of this city. Respiratory diseases, dysentery, diarrhoea, pneumonia, cholera and tuberculosis take a heavy toll of life every year. Some of the diseases are seasonal and therefore could be anticipated and the mortality reduced by precautionary measures. Infant mortality is also high particularly in the densely habited inner zone of the city.

#### **86. Distribution of Population in the Mutha Basin.**

G. S. KULKARNI, Poona.

The basin of river Mutha, above 384 sq. miles in extent, includes some portions of the talukas of Mulshi, Velhe, Haweli and Poona City. It has a population of well over 33,000 people (Poona City is excluded, 1951). It lies within the influence of the S. W. Monsoon; the rainfall varies from 150 inches in the westernmost parts to about 26 inches near Poona in the easternmost part.

No large-scale industries could be started as this region is poor in minerals. Agriculture, therefore, is the main source of maintenance. Availability of arable land and supply of water are the main deciding factors in the size and population of the settlements.

Accordingly the western part of the basin has a large number of smaller settlements situated mostly along the water-courses. Their population is mostly 500 or below each. Some favourable situations, e.g. nodal positions and accessible areas, are occupied by slightly larger settlements.

The eastern part of the basin is wider and has more level land for agriculture. Water is made available by the Mutha canals, and by some wells. Here are raised vegetable crops for the nearby Poona market which is easily accessible round-the-year. Settlements are of big size with their populations varying between 500 and 1500 inhabitants each. Two settlements, whose populations are even more than 2,000 each, owe their large sizes mainly to the nearby National Defence Academy.

#### 87. A study in Land-utilization of Walgaon Village (Amravati).

NEMIKUMAR JAIN, Amravati.

Walgaon village, five miles from Amravati, is on a plain, drained by the river Pedhi and its tributaries Renuka and Waghadi.

The soil is a deep black regur of varying degree of fertility, this being dependent upon the amount of salt present in soil. Soils near R. Pedni are good for plantation.

The climate is generally healthy, though the rainfall is uncertain and irregular.

Nearly 50 p.c. of the land is in the hands of the Jahagirdars and hence there is a large class of landless labourers. There is also unusual population pressure on land.

Juar, cotton and wheat are the main crops. Plantation is important south of R. Pedhi.

Irrigation, though needed, is not possible as the surface and ground water is brackish. The irrigation problem can be solved by construction of a dam across R. Pedhi.

For proper land use, pastures should be provided to increase cattle population. Since fertilizers are not suitable, green-mannres should be obtained in huge quantity from them. Other forms of farming as Dairy Farming, Poultry Farming should be developed. Double-cropping should be increased by showing Mung as a kharif crop and wheat as a rabi crop in the same field.

#### (iv) Urban Geography

#### 88. Changing phases of the Township of Hajipur.

N. K. SINGH, Banaras.

Hajipur (25° 41' : 85° 12') situated on the eastern bank of River Gandak about 7 miles north of its confluence with the Ganga is a fine example of break-of-bulk town. It is a nodal centre for trans-Ganga tract east of River Gandak as it is on the mainline of N.E. Rly. and is connected with Sonapur on the west, Muzaffarpur on the north, Barauni in the east and Patna in the south by railway cum steamer. There is a regular Cargo steamer service between Hajipur and Patna and thence to east and west through the Ganga.

There is a fort in ruins on the high ground along the River Gandak, which is said to date from the Hindu period, but no Hindu name is assigned to it

nor to the town. Historical records point that it was founded by Hazi Ilyas Khan, the king of Bengal between 1345 and 1358 A.D. The town extended upto Mahner (20 miles to the east) and to Godai Sarai (4 miles to the north). Perhaps it lost its former glory and importance partly due to the mutiny of 1574 between Akbar and his Afghan Governors of Bengal and partly due to the transfer of the then seat of the Government to Patna.

Three main phases of evolution can be traced : (1) Before 1345 A.D. : It is said that Rama halted on his way to Janakpur and Ram Navami fair is annually held to mark the occasion, (2) Between 1345 and 1575 A.D. : When the fort was constructed and houses were built haphazardly in the beginning and were clustered later on to form a compact settlement. At this time the township achieved the climax of its glory and cottage industries were developed considerably and (3) After 1575 A.D. : When the city declined as its former service area was encroached upon by Patna and Mujaffarpur.

At present it is the subdivisional headquarters and caters for the needs of a relatively small area. Its former industrial activity also has now declined. It is still well reputed for its plantains which is in great demand in most parts of Bihar.

The town has not been able to recover since Akbar's rule and it may be remarked that the construction of Mokameh Bridge will further reduce its importance.

#### 89. Functional Landscape of Patna.

USHA ARORA, Banaras.

Patna is a town of pre-historic times in the middle Ganga Valley and is a river-side city with a ribbon like pattern following the natural levee.

The character of the town-scape is intimately related to various functions of the town—business, industry, residence, administration and education.

Trade and Commerce employs over 1/5 of the total population. There are 4 main business areas—(i) The main Commercial area clings to the main axial road of the city. The eastern half of this presents an over crowded picture while the western one is a magnificent shopping parade. (ii) The grain market area is at Marufganj. (iii) The Vegetable market area lies in Massallahpur in the Southern suburb. (iv) A general market is along the station road.

Next to business is industry employing about 1/10 of the total population. The large-scale industries are few while small-scale and cottage industries are common, the most important one being handloom spinning and weaving.

The residences are often interspersed with the commercial or industrial establishments in the city proper. However, some residential patches may be identified :—(i) Eastern extremity of the city lies in the east of the Commercial Zone, (ii) Kadam Kuan and its neighbourhood and (iii) Civil lines. Patna has been the capital in the Gupta and Mauryan dynasties. It is the present capital of the State of Bihar. From the point of education and culture it has been famous from time immemorial. Patna has now a university with several colleges and technical institutions. In addition there are some public libraries with very rich collections. It is also a religious center for Sikhs, Buddhists and Hindus. Patna lacks parks and playgrounds. The only playground is the Gandhi-Maidan and the only park is the Hardinge Park. Health services are well provided. The General Hospital is one of the biggest and well equipped hospitals in northern India.

**90. Two Small Towns of Eastern U.P. : Sultanpur and Chunar.**

R. L. SINGH, Banaras.

The two small towns of Sultanpur and Chunar in Eastern U.P. with a population of less than 20,000, have a great historical past and their present decline is due to historical accidents and change in strategic significance. The causes for their decline is analysed in detail in this paper.

**91. Trend of Urbanisation in the Punjab Plain during the Twentieth Century.**

A. S. JAUHARI, Varanasi.

In the Punjab Plains Division and PRPSU there has been a growing tendency towards urbanisation of population in the present century. It is interesting to note that whereas the total population increased by 21.4 percent since 1901, the urban population was more than doubled in the same period. With the exception of 1911 when the town population registered a decrease of 11.7 percent over that of 1901, no other decade shows any decline. Changes in the economic and political conditions of the region have been the primary factors in bringing about this change. The region however, does not contain big urban agglomerations and it was not until 1941 that it could boast of having more than one city. Since 1941, only Amritsar, Jullundhr and Ludhiana have been cities with over one lakh population. The majority of the people, however, are concentrated in the medium-sized towns.

The process of urbanisation has been accelerated by partition. The lack of cultivable area, a great expanse of dry zone in the southern and south-western part, and the desire on the part of the displaced persons to be able to earn their living in the shortest possible time, resulted in the concentration of population in towns both large and small. It is evident from the fact that the number of class VI towns which was on the decline since 1911 increased suddenly between 1941 and 1951. Industrial expansion is likely to attract further the people to the towns, but greater irrigation facilities and more stable conditions in the villages may slow down this process of urbanisation.

**92. Umland of Modinagar.**

A. B. MUKHERJEE, Udaipur.

The social, cultural and economic linkages of the umland of Modinagar have been discussed in this paper. Griffith Taylor's concept of cultural linkage has been added to the social and economic linkages. Being an industrial oasis in the desert of agriculture, its importance as a sales and service centre is very great. The number of economic linkages is the largest while in the cultural category the number is the least. As the town and its umland both take from and give to, each other, the supply and dispersal both have been studied.

The shapes of the different tributary areas and their extent have been described and explained. It has been found out that the umlad of Modinagar is essentially a pargana feature as the greater portion of the umland extends over the pargana. The study of the umland has also revealed that Modinagar is the biggest centre of the pargana for all social, economic and cultural services.

## (v) Human and Cultural Geography

**93. Gaddis of Dhauladhar—A Study in Human Ecology.**

S. L. KAYASTHA, Banaras.

The Gaddis are semi-pastoral and semi-nomadic people who inhabit the slopes and spurs of the Dhauladhar range in the north of the Himalayan Beas Basin; their habitations lie between 3,500' and 7,500'. Climatic conditions vary from modified tropical to sub-arctic. Summers are cool but winters are severe and snow lies deep. Rainfall is heavy on the southern flanks.

The mountainous habitat has strongly influenced their economy and society. 90% of the area is unfit for cultivation. Forest meadows and alpine pastures abound and sheep and goat rearing—'making wealth out of living wealth'—is the chief occupation. There is intermingling of subsistence agriculture and pastoralism. Over a large area it is difficult to grow more than one crop in the year. Farming methods are primitive. Severe winters and lack of fodder compel the Gaddis to migrate with their flocks to lower valleys. Autumn, winter and spring are mostly spent in the valleys and southern slopes of Dhauladhars and in summer Gaddis cross over to the leeward side to avoid excessive rainfall. Thus, transhumance is an established practice. Semi-nomadism results from both primitive agriculture and pastoralism. Escaping the damp heat and severe cold due to seasonal migrations, the Gaddis are healthier than the other inhabitants of the hills. Due to necessity of constant migration, the Gaddi lives on the barest necessities of life. He camps out in the open under the cover of sky. His other equipment consists of few pots and pans, sheep-skin bags for provisions and blankets. His dress resembles that of a hill-scout. His food consists of sheep and goat's milk and bread of maize or barley. On high alpine pastures, he can subsist on milk for days together. His capacity for enduring fatigue, cold and hunger is tremendous—a necessary practice for nomadic life.

Living in harsh environment, the Gaddi feels over-awed by nature and sees spirit in every rock, tree and spring, and propitiates it before undertaking any operations. He also consults 'Spiritmen' whenever any calamity overtakes him. Gaddis worship sheep as others worship cow in the plains—an example of worship of means of livelihood. Unlike most nomadic people, Gaddis are free from crime. Secluded from the marring crowds of civilization, they have maintained a distinct culture pattern of their own. With their old customs, quaint dress and manners, Gaddi life goes on an easy pace. The resistance to rapid changes indicates that the economy is firmly based on natural environmental conditions which are hard to change. By and large this mountain economy is self-sufficient and the socio-economic pattern does not show any signs of breaking down. With the passage of time and new requirements, it is bound to be modified but fundamental socio-economic responses will remain unaltered.

**94. Settlement Studies in the Lower Kali Basin, North Kanara District.**

M. S. HONRAO and V. R. PRABHU, Dharwar.

To the human geographer, the Lower Kali Basin offers an interesting field for the study of coastal settlements. Curiously enough, the settlement map of the basin brings out the close relation of the settlements with geomorphological features. Depositional features like alluvial flats, flood plains and alluvial islands have supported dense agricultural population whereas the erosional features like the highly dissected granitic uplands and lateritic knolls covered with forests are

less attractive for settlements. Besides, marine and riverine conditions have supported fisheries all along the water front.

The settlements are (1) almost uniformly dispersed, (2) usually of small size because of dispersion and (3) are distributed more along the riverbanks and coast than elsewhere. The house types are also almost uniform.

The following classes of settlements can be recognised with reference to their siting in the first instance and the major function in the second: (1) Shore-settlements given almost wholly to fishing; (2) River-bank settlements developed near convenient landing places; (3) Roadside settlements sometimes showing linear pattern; (4) Settlements along the contact line of the hills and the agricultural lands below; (5) Settlements on the alluvial islands; (6) Valley settlements commanding the alluvial flats and (7) Forest settlements which are small and developed in forest clearings. Lastly come the "Census towns" which are somewhat urbanised and also bigger sized; leading among these is Karwar, which dominates the whole region.

#### **95. Nomenclature of the Jat Villages.**

A. B. MUKERJI, Udaipur.

The nomenclature of the Jat villages in Upper Ganga-Jumna Doab, based on six principal factors, geographical, economic, historical, religious, ethnical and mythological, has been studied in great detail in this paper. Valuable data about the early pastoral economy, the later agricultural economy, the turbulent times with the necessity for defence, the scant regard for their religion and their recent immigration in Upper Ganga-Jumna Doab have been secured from the study of their village-names.

#### **(vi) Miscellaneous**

#### **96. Tanjore—A Study in Historical Geography.**

M. S. VISHWANATH, Varanasi.

The present paper deals with the important geographical development that occurred during the ancient period in Tanjore. Tanjore covers the whole of the Cauvery (or Kaveri) Delta, the mention of which is found even in the ancient classics like Valmiki's Ramayana. The Greek geographers like Ptolemy have also referred to it and described two towns as 'Khabaris', an Emporium at the mouth of the river Khaberos.

Some changes have occurred in the course of the river Kaveri during the Historic periods. Tamil epics state that there were two courses of Kollidam (Coleroon) and Kaveri, namely, old and new channels. But the channels which have been described as forsaken, show very little affinity to a river. At the same time, Ptolemy's description of Khabaris as a flourishing port at the mouth of Khaberos, confirms the fact that the river was very voluminous. The present channel of Kaveri is very narrow and that too remains devoid of water during the dry season, especially in the lower reaches.

Tanjore is proud of its ancient culture. Flood protection measures and irrigation facilities were available even in those olden days, when people in other parts of the world knew very little about canal irrigation. This can be evidenced by the fact that an embankment was constructed along the river, as far back as 6th century A.D. when Karikalan was the Emperor of the Chola dynasty. It is

so strong that it has withstood the ravages of nearly 1,500 years. Some of the canals like Venuar and Arisilar, date back to the 2nd century A.D. Rajaraja I who flourished during the 10th and the 11th century A.D. undertook this work and was responsible for the construction of most of the canals. It was only during his regime in the year 1004 A.D. that a definite system of land survey was brought in, and a land as small as  $\frac{1}{52,428,800,000}$  of a veli (veli=7 acres) was measured.

He was also responsible for a proper settlement survey for the suitable location of villages and towns. The habitations were divided, and sub-divided according to their importance. The number of towns and villages in the greater divisions called 'Nadus' was also limited. There was a definite plan for the construction of the houses, looking after all the amenities required for the family. Every caste and community had its own location in a town or village. Temple was a common feature both in the village and in the towns. The temples were great centres of learning, but there were also some other essential features for a town like, a castle, a moat, forest just at the entrance, marketing centres, orchards and a market for sweet scented flowers at the entrance. The last one can be found even now by the name of 'Poo-Kara-Teru' (Flower Seller's street) in the South-south-eastern corner of the Tanjore town. The towns also contained feeding places for poor people and visitors to the town.

Trade and commerce was at the peak during the regime of Rajaraja I and of his successor Rajendra Chola I. It is said that the latter had conquered Sumatra and Java, besides Ceylon, and had sent an Ambassador to China in 1033 A.D. The leading port at that time was Kaveripattanam.

#### 97. Spheres of Economic Influence and Power Potentials.

B. N. MUKERJI, Calcutta

This is a study of the resources of the big world powers including their dominions and colonies, after the second world war, with a view to assessing the Role of Geography. Modern wars are not fought for territorial expansion but for creating spheres of economic influence which ultimately determine the foreign policy of the big and powerful countries, irrespective of their size. A geographical analysis has been made which is expected to clarify the position of these spheres of Economic Influence and the country or countries bestowing their powers on them.

#### 98. Determination of Soil Organic Matter.

S. VENKATARAMAN, Calcutta.

Two methods viz., Walkley Black's method and modified Scholtenberger's method (Hallsworth and Lahiri) have been tried for the determination of organic matter in soils. In the modified method a very small quantity of finely powdered soil is taken in a conical flask and heated for 10 minutes at 175°C. with 20 c.c.  $N/2$   $K_2Cr_2O_7$  and 20 c.c. of concentrated  $H_2SO_4$  over a bunsen flame instead of in a sulphuric acid bath for one and a half to two minutes. The un-reduced dichromate is determined by the addition of  $N/2$  ferrous ammonium sulphate with 0.5% diphenyl amine as indicator.

It has been found that the recovery value of heavier soils is higher when the modified Scholtenberger's method is used. It is also found that the time factor does not stand in the way of adopting the modified method for routine analysis.



**99. Methods of Isopleth Mapping.**

SIVAPRASAD DAS GUPTA, Calcutta.

The paper deals with the common procedures of drawing various kinds of isopleth maps.

A method is described for deriving isopleth lines from dot maps. In those dot maps where dots are drawn with clarity and therefore are countable, it is quite possible to calculate the density of dots per unit area all over the map. The dot map may be divided into suitable small blocks of either square, circular or any other shape, the density values then worked out for each unit area and the isopleth lines drawn with these values. Various methods are described for calculating the density values.

Possibility of using photographic method is also indicated in the present paper.

## SECTION OF BOTANY

*President :—*PROF. S. N. DAS GUPTA.

### *Abstracts*

#### (i) Viruses

##### 1. Studies on a bacteriophage of *Escherichia coli*.

S. K. BOSSE, Lucknow.

The paper deals with the effect of ultra-violet radiation on the activity of free and adsorbed phage, and the inactivation rate of the phage as induced by heat energy. The pH stability of the phage has been determined.

The rate of adsorption of the phage to the host and the intracellular growth of this virus has also been studied in detail.

As far as the author is aware this phage, active on the communis strain of *Escherichia coli*, has not been recorded before.

##### 2. Top Necrosis of *Cyamopsis psoraloides* D.C.

G. S. VERMA and P. N. SAXENA, Lucknow.

*Cyamopsis psoraloides* D.C. (Guar) is widely cultivated in many parts of India and is used as a food and forage crop. This was found to be infected by a virus disease hitherto undescribed from India. The incidence of infection in the field was observed to be about 90%.

The initial foliar symptoms were yellowing and stunting, rarely a chlorotic mottling. On leaflets small chlorotic depressions were observed which later became necrotic. Subsequently these coalesce and the necrosis spreads downwards through the petiole to the stem. The inflorescence was also found to be affected. As the season advanced there was a general necrosis of the stem and growing point, the young leaflets began to shed and finally a bare stem was left with some bronzed, curled necrotic leaves.

Transverse sections of the leaflets revealed that the necrosis started superficially from epidermal cells; later it spread deep into the mesophyll.

The disease was found to be sap-transmissible to *Cyamopsis psoraloides*, *Phaseolus vulgaris*, Tobacco and *Datura stramonium*. The thermal inactivation and dilution end point were found to be 70° (approx.) and 1:1,000 respectively.

There is great possibility of the disease being seed transmitted in view of the observations made.

The disease was first observed by K. Starrchester in 1944 in Oklahoma and subsequently described by Cooper (1949).

As far as the authors are aware there is no record of the disease from India.

## (ii) Bacteria

**3. Studies on the sporogenesis of Bacilli in fluid medium—I. Sporulation of *Bacillus Subtilis*.**

S. K. MAJUMDER and M. C. PADMA, Mysore.

The fermentation media were tested for the sporogenic action on the vegetative cells of *Bacillus subtilis*. D-xylose in contrast to other sugars exerted sporogenic influence. Effects of buffering the fermentation broths with phosphate buffers to rectify the adverse effects of different carbohydrates on the reaction of the media which influenced the sporulation of the organism were studied. A comparative study on the actions of different pentoses (Ribose, Xylose and Arabinose) on the growth and cellular morphology of the vegetative cells of *B. subtilis* has been made. The influence of xylose on the growth phases and spore yield in shake culture of the organism have also been reported. The authors have indicated the possible mechanism of sporogenic stimulation by D-xylose on *B. subtilis* in this paper.

**4. Survey of Antagonistic Bacteria Isolated from Soils of India and Indonesia.**

MIRA PURKAYASTHA and P. N. NANDI, Calcutta.

From 123 soil samples collected from India and Indonesia, 500 bacteria were isolated which exhibited antagonistic properties in the soil dilution plates. Of these 312 (62.4%) isolates were found to be active against at least one of the following test organisms :

*Aspergillus niger*, *Curvularia* sp., *Fusarium vesicinctum*, *Helminthosporium sativum*, *Alternaria solani*, *Staph. aureus*, *E. Coli*, *Eb. typhosa* and *V. cholerae*. These were inhibited respectively by 19%, 44%, 24%, 33%, 22%, 33%, 13%, 9%, and 13% of the cultures. 24 cultures inhibited all the test fungi, 45 inhibited all the test bacteria and 3 were antagonistic to all the test organisms.

When the bacteria were grown on Potato-peptone-broth, the pH increased from an initial value of 7.4 to 8 or above. In many cases maximum in the antibiotic titre was reached in 24 hours. Inspite of heating at 100°C for 30 min. the antibiotic property was retained by 73% of the culture filtrates but only 16% could stand autoclaving at 120°C. The antimicrobial spectra of the heated or the autoclaved samples were not always similar to those not heated.

**5. The Sugars of *Azotobacter indicum*.**

M. PURKAYASTHA and P. NANDI, Calcutta.

*Azotobacter indicum* Starkey and De is remarkable for its gummy nature. When 80% ethanol extract of 7 day old cells are subjected to paper chromatography on Whatman No. 1 filter paper with phenol-water, butanol-acetic-acid-water 2:1:1, butanol-pyridine-water 10:3:3 and tertiarybutyl alcohol-0.25% picric acid 4:1. 3 sugars are detected : glucose, fructose and sucrose. When the residue from 80% ethanol extract is washed and refluxed in 90-95% formic acid or N HCl for 3 hours, evaporated to dryness, dissolved in pyridine and chromatographed as described above, the same sugars are obtained. Glucose has the highest concentration.

## 6. The Amino-acid Composition of Four Species of *Azotobacter*.

M. PURKAYASHA and P. NANDI, Calcutta.

The amino-acid composition of four species of *Azotobacter* viz. *Az. indicum*, *Az. vinelandii*, *Az. chroococcum* and *Az. agile* has been studied by paper chromatography. These were grown on mannitol (or sucrose) phosphate agar for 7, 10 and 15 days and extracted in 80% ethanol, filtered and aliquots of the concentrated filtrate chromatographed to dimensionally on Whatman N. 1 filter paper with phenol water and butanol acetic acid water 4:1:1 as the developing solvents. The residue was hydrolysed with 6 N HCl in a sealed tube at 110°C for 36 hours, evaporated to dryness, dissolved in water, aliquots chromatographed. The ninhydrin positive substances were eluted in pyridine water 2:8 and the concentration of aminoacids estimated colorimetrically.

Free aminoacids in *Azotobacter* are very few particularly in *Az. indicum*. In the acid hydrolysis however a large number of aminoacids are present and in high concentration. These are aspartic acid, glutamic acid, glycine, serine, lysine, cystine, glutathione, ornithine, arginine, threonine, alanine,  $\alpha$ -aminobutyric acid, valine, proline, phenylalanine and leucine. Glutamic acid is present in the highest concentration in all the cases. The nitrogen which is fixed by these organisms is thus rather quickly converted to protein.

### (iii) Algae

## 7. Studies in the various modes of perennation of blue-green algae of Annamalai-nagar.

(Miss) SAROJINI MENON, Annamalai-nagar.

This study pertains to the various modes of perennation of the sub-aerial blue-green algae of Annamalai-nagar. Observations were made during the months of May, June and July when the drought was at its zenith.

Four important modes of perennation have been observed:

(a) The non-filamentous types perennate by means of *nannospores* which are spores formed by repeated cell-divisions. In *Chroococcus* 8 such spherical spores are formed within a cell. In *Gleotheca* and *Aphenocapsa* the number of spores is indefinite: *Gleotheca* having hemispherical and *Aphenocapsa* having spherical spores.

(b) In some cases where the trichomes are aggregated together as in *Microcoleus* and *Tolypothrix* each trichome gets separated as a 'filament' having an independent mucilaginous covering during dry seasons.

(c) A majority of the members, however, tide over the unfavourable conditions by the formation of *hormocysts*, which are short lengths of the trichomes with rounded ends and abundant mucilage. In *Oscillatoria* and *Lyngbya*, they are broken parts of the trichome; in *Calothrix* and *Rivularia* they are formed from the cells below the terminal hair; and in *Scytonema* they are developed from the tips of the branches. The number of cells in a hormocyst varies from one to twelve.

(d) In addition to these, perennation takes place also by the formation of *akinetes* which are specialised spores. This has been found only in a few members like *Aphanizomenon*, *Nostoc*, *Calothrix* and *Gleotrichia*. Akinetes have thicker walls and abundant food reserve.

**8. Some new hosts of Cephaleuros from Bihar.**

A. S. YADAV, Patna and J. G. SRIVASTAV, Lucknow.

Twenty hosts of *Cephaleuros* collected from different parts of the state have been reported. It is interesting to note that of the large number of monocots examined so far, not one was found to be associated with the Alga.

The alga on *Macranga deuliculata* Mnell, *Millitea auriculata* Baker. and *Swietenia macrophylla* King. seemed to be parasitic as well-stained free hand section through the algal lesions showed penetration through the leaf lamina and discoloration of the tissues extending sometimes into the mesophyll. In case of *Piper longum*, L. the alga is also parasitic as reported (Sharples, 1923).

In the rest of the cases it was found to be simply epiphytic.

**(iv) Fungi and Plant Diseases****9. Effect of different Carbon sources on the production of a Fungistatic substance by an Actinomyces Antagonistic to *Alternaria solani* and *Helminthosporium oryzae*.**

K. C. BASU CHAUDHARY, Agra.

A fungistatic substance, produced by a species of Actinomyces, was reported (Basu Chaudhary 1956) to be antagonistic to the growth of *Alternaria solani* and *Helminthosporium oryzae*. Presently the effect of 8 different carbon sources (Xylose, Galactose, Glucose, Sucrose, Maltose, Lactose, Glycerol and Mannitol) at equivalent carbon concentrations was investigated on the production of the fungistatic substance. The fungistatic potency was measured by Serial Dilution technique at regular intervals of 7, 10, 13 and 16 days after which the dry weight of the mycelium was taken to find out the amount of growth. Glucose was found to be the best carbon source for the production of the fungistatic substance. Next in order came galactose, maltose and lactose followed by sucrose and xylose. Glycerol and mannitol were the poorest sources.

**10. Market diseases of fruits and vegetables in Kumaon. I. Cottony leak of beans (*Phaseolus vulgaris*).**

K. S. BHARGAVA and S. C. GUPTA, Naini Tal.

During the summer of 1955 a serious disease of stored beans with abundant cottony mycelium and leaky appearance was noticed in Naini Tal market. The causal organism was brought into culture and identified as *Pythium de Baryanum*. The parasite is unable to infect sound tissues but enters through a wound. The infection spreads very quickly at 20° to 25°C. Careful handling and other sanitary measures help in eliminating the disease. The spores of the fungus are carried from the soil on the pods before they are picked up.

**11. Market diseases of fruits and vegetables in Kumaon. II. Rhizopus rot of Plums (*Prunus communis*).**

K. S. BHARGAVA and S. C. GUPTA, Naini Tal.

A serious rot of ripe plum in Naini Tal during summer months as found to be due to a species of *Rhizopus*. The affected areas became very soft and the entire fruit soon got covered by abundant mycelium and a mass of black sporangia within a short period. At room temperature (19°-21°C) the mycelium penetrated

the tissue and the entire fruit became mouldy. The organism is capable of infecting peach but does not infect pears, apples or persimmons. Experiments showed that it is a wound parasite. The most suitable temperature for its spread was found to be 25°C. Rhizopus rot can be reduced by careful handling to prevent mechanical injury and segregating sound fruits from the cracked ones. Keeping the fruits at low temperatures during transit will greatly eliminate the spread of Rhizopus rot.

## 12. The Pezizaceae of the Mussoorie Hills—V.

K. CASH, K. S. THIND and L. R. BATRA, Amritsar.

This paper deals with the three new species of Pezizaceae collected recently from the Mussoorie hills. These belong to the genera *Sphaerospora*, *Humarina*, and *Humaria*: 1. *Sphaerospora* (sp. nov.) does not agree with any described species found. It differs from *S. patagonica* Rehm in smaller spores (12–15 $\mu$  in diameter), and from the other red species of the genus in smooth spores. 2. *Humarina* (sp. nov.) is differentiated from all other species of the genus in the chocolate-brown colour of the apothecia and the long, broadfusoid spores (25–33  $\times$  7.8–10 $\mu$ ). 3. *Humaria* (sp. nov.): No species of the genus has been found which agrees with this in the brown hymenium, fasciculate hairs and large, smooth spores (17.5–26.4  $\times$  10.5–13 $\mu$ ). It resembles *Humaria gilva* Bond. which, however, is found on burnt places and possesses smaller spores without any guttules.

## 13. Disease intensity and crop-loss estimates in the Wilt of Gram.

S. K. CHAUHAN, Agra.

A preliminary investigation was made on wilt of gram (*Cicer arvense* L.) caused by *Fusarium orthoceras* App. & Wr. with reference to disease intensity and crop-losses. The tempo of disease development in relation to soil temperature was also studied. A suitable technique was developed to measure the disease intensity by reducing the visual observations of symptoms to a quantitative index depending upon the period and extent of wilting. The data were analysed statistically and correlation and regression coefficients were determined. The average disease intensity score per plant was 72.931 ( $\pm 1.680$ ) and 73.550 ( $\pm 2.060$ ) and the loss in yield 12.489g. ( $\pm 0.470$ ) and 13.471g. ( $\pm 0.846$ ) in two fields respectively, indicating that the loss in yield is highly significant and that there is a definite relationship between disease intensity and loss in yields. The correlation coefficients ('*r*' values), significant at 1% level, are 0.929 and 0.403 in the two fields respectively. Regression coefficients ('*b*' values) were calculated since '*r*' values are significant, and indicate that for each 1% increase in the disease intensity, losses in yield in the two fields amount to 0.261 gms. and 0.166 gms. respectively. In order to find out whether the two '*r*' values (0.929 and 0.403) differ significantly from each other, standard error of the difference between the two '*r*' values is calculated and found that the difference (1.2238) between the two '*r*' values is more than twice the standard error ( $\pm 0.146$ ) indicating significant difference which is also seen in the 'scatter' of the graphs.

The tempo of disease development indicates that the disease is in a dynamic state and increases steadily and is closely associated with increase in soil temperature.

**14. Physiologic variation in isolates of *Fusarium Orthoceras* causing Wilt of Gram.**

S. K. CHAUHAN, Agra.

A cultural study of some isolates of *Fusarium orthoceras* App. & Wr. causing wilt of gram in Agra district revealed significant variations. A preliminary investigation was made with nine isolates. Physiologic variations with regard to radial spread, colony characters, type of mycelium and dry weight were studied, and three distinct forms appear to constitute the nine isolates. Physiologic variation accompanied with variability in pathogenicity has been observed earlier by a number of workers in Fusaria, (Brown 1925, Subramanian 1952, Varma 1954), and work on these lines will be taken up.

**15. Effect of methods of cultivation on the incidence of "Brown spot" disease in Aus (autumn) paddy.**

S. B. CHATTOPADHYAY and N. K. CHAKRABARTI, Calcutta.

While searching for varieties of paddy resistant to the infection of *Helminthosporium oryzae* Breda de Haan (the causal organism of 'brown spot' disease), under conditions in West Bengal, it has been observed by Chattopadhyay and Chakrabarti (1955. Proc. Ind. Sc. Cong.) that the varieties differ in their degree of resistance to the infection of the pathogen. It has further been observed that the reaction of an individual variety is also variable under varying condition affecting growth and metabolism of the host. 'Aus' (Autumn) paddy in West Bengal is grown under both broadcast and transplanted condition. Observations were made on six different varieties of 'Aus' paddy grown under both broadcast and transplanted condition in replicated and randomized plots for two consecutive years. Data taken of leaf and grain infection, show that the intensity of infection of leaf as well as grain in any variety, is always more when grown under the transplanted method of cultivation as compared to that under the broadcast method of cultivation. It was further observed that the difference among the varieties in their reaction to infection is more pronounced under broadcast method of cultivation. No correlation was observed between the intensity of leaf infection and grain infection.

**16. Relationship between anatomical characters of leaf and resistance to infection of *Helminthosporium oryzae* in paddy.**

S. B. CHATTOPADHYAY and N. K. CHAKRABARTI, Calcutta.

Varieties of paddy grown under same conditions and exposed to the same degree of infection, vary in their degree of resistance to the attack of *Helminthosporium oryzae*. Infection of paddy leaves by *Helminthosporium oryzae* has been observed to take place by direct mechanical penetration of the cuticle. So observations were made to find out whether variation in resistance noted among the different varieties, in this case, is correlated with the characteristic anatomical features of the leaf. Data were taken of the thickness of the outside and epidermal cells, number of silicated epidermal long cells and epidermal bulliform cells and SiO<sub>2</sub> content of the leaves of five different varieties of paddy, showing varying degrees of infection, namely Patnai 23, Asra 108/1, Bhasamanik, Tilak-kachery and Badsabhog 72. In varieties Asra 108/1, and Badsabhog 72 showing more leaf infection consequently more to the attack of susceptibility the pathogen, total thickness of the cuticle and the epidermal layer, particularly the latter is

comparatively much low. Varieties Asra 108/1, and Badsabhog 72 also have fewer number of silicated bulliform cells, in comparison to others. No correlation was however observed between  $\text{SiO}_2$  content of the leaf and resistance to infection.

#### 17. Saltation in *Helminthosporium oryzae* Breda de Haan.

S. B. CHATTOPADHYAY, and C. DAS GUPTA, Calcutta.

Study of twenty-three isolates of *Helminthosporium oryzae* in West Bengal, reveals that saltation is rather frequent in the fungus under certain conditions. In cultures, localized mycelial areas arise differing strikingly in appearance from the rest of the mycelial growth being white in appearance. These localized patches constitute saltant areas. Four distinct types of saltation varying in mode of appearance of saltant areas are noticed. Temperature of  $26^\circ\text{C}$  has been found to be most favourable for the appearance of the saltant areas. At  $31^\circ\text{C}$ , saltation is irregular and saltant areas are often ill-defined. At  $21^\circ\text{C}$ , saltation is very infrequent, particularly in Richard's agar. Saltation was more pronounced in maize meal agar and oatmeal agar than in Richard's agar. Sporulation is practically absent in a typical saltation area. The very few conidia that are produced in a saltant mycelial patch are smaller in size ( $32.3-91.2 \times 7.6-13.4 \mu$  upto 7 septa, average size  $62.7 \times 11.4 \mu-5$  septa) as compared with normal size  $34.47-158.95 \times 7.66-17.24 \mu$  and upto 12 septa. Reversion to original parental black mycelial form takes place gradually at  $21^\circ\text{C}$  on repeated subculturing. But at  $26^\circ\text{C}$  complete reversion to parental form does not take place, even after a number of generations in subcultures.

#### 18. The Clavariaceae of the Mussoorie Hills—II.

H. J. H. CORNER, K. S. THIND, and G. P. S. ANAND, Amritsar.

In this paper five new species and two new varieties of Clavarias collected from the Mussoorie hills (5,000--7,000 ft. altitude in the North Western Himalayas) are described:—1. *Ramaria flaviceps* sp. nov. which is closely allied with *Ramaria flava* (Fr.) Quél., but differing in the much smaller spores ( $7-10.5 \times 4-5.3 \mu$  against  $11-18 \times 4-6.5 \mu$  spore size of *R. flava*) and unchanging flesh. 2. *R. flaviceps* sp. nov. var. *cremea* var. nov., which has wide and more clearly marked spores than the type form and lacks the yellow tips to the branches. 3. *R. clarebrunnea* sp. nov., which resembles *R. holorubella* (Atk.) Corner but it lacks the red brown and vinaceous colours. 4. *R. camelicolor* sp. nov., which is characterised by the large, profusely branched, very light camel-brown or buff coloured fructifications, and clamped hyphae. 5. *R. camelicolor* sp. nov. var. *rufa* var. nov., which has faintly red fruit bodies. 6. *Clavulina hispidulosa* sp. nov. which is characterised by the possession of fascicles of hyphae in the hymenium which is thus described here as minutely hispid. 7. *Clavaria amoenopsis* sp. nov., which is characterised by simple, very pale orange-yellow fruit body, and hyphae and basidia without clamps.

#### 19. The Clavariaceae of the Mussoorie Hills—VII.

H. J. H. CORNER, K. S. THIND and SUKH DEV, Amritsar.

This paper deals with four new species of Clavarias collected from the Mussoorie hills (5,000--7,000 ft. altitude in the North Western Himalayas) during August and September, 1954-55. These belong to the genera *Pterula*, *Ramaria*,



and *Typhula* :—1. *Pterula decumbens* sp. nov. is characterised by the decumbent habit and the prostrate main axis giving out laterals. The presence of prostrate to sub-erect main axis which is attached at places by rhizoidal branches and giving out sub-erect to erect laterals in a feature peculiar to this fungus. This fungus is intermediate in its growth habit between *Pterula* and *Allantula* and is interesting in showing how the loss of erect habit has occurred. 2. *Ramaria echino-virens* sp. nov. is a distinct new species, which from the virescence, must be near *Ramaria*, *ochraceo-virens* (Jung.) Donk. However, it is differentiated from the latter in having larger fruit bodies, larger and more strongly echinulate spores. 3. *Typhula longispora* sp. nov. which is characterised by the rather long and narrow spores. 4. *Typhula* species (sp. nov.) which has not been named as yet. It is characterised by the hymenial cystidia. *T. virgata* Remsberg has similar spores, but stouter fruit bodies and different sclerotial structure.

**20. Biometrical studies on Uredospores of *Puccinia penniseti* Zimm. causing rust disease of Bajra (*Pennisetum typhoides* Stapf. & Hubb.)..**

G. G. DALELA and S. SINHA, Agra.

Physiologic specialization in *Puccinia penniseti* Zimm. causing the rust disease of bajra (*Pennisetum typhoides* Stapf. & Hubb.) reported by Basu Chaudhary & Sinha (1955) was put to the test of comparative morphology of the uredospores, as indicated by width-to-length ratio (l/w ratio). As a preliminary measure only eleven samples of the rust, collected from different localities were examined. Following the technique of Levine (1928) one hundred uredospores from each sample were measured and the results analysed statistically following the 'analysis of variance' method.

The results indicate that uredospores from closely situated localities in Agra District can be grouped in three categories (l/w ratios : 1.220, 1.281–1.330 and 1.369), and in Jaipur District into two categories (l/w ratios : 1.238 and 1.297). Uredospores from widely separated localities (Agra, Jaipur, Kanpur, Nagpur and Poona) fell into three categories (l/w ratios : 1.238, 1.281 and 1.430–1.454). When all the samples were combined in one calculation, only four categories (l/w ratios : 1.22–1.238, 1.281–1.330, 1.369 and 1.430–1.454) were obtained, and curiously enough samples from Kanpur, Nagpur and Poona fell into the same category. Extended work on the above lines is in progress.

**21. Amino acids from vegetative mycelia and rhizomorphs of *Armillaria mellea*.**

A. DASGUPTA and P. N. NANDI, Calcutta.

Amino acid contents of the rhizomorphs and the vegetative mycelia of *Armillaria mellea* were studied by the paper chromatographic technique. After growing the fungus in 2% malt solution for 60-70 days, when profuse rhizomorphs came out, these were cut out, washed, dried and a weighed amount (dry wt.) was hydrolysed with 6N HCl for 36 hours. The vegetative mycelia were likewise dried and the same amount (dry wt.) was treated in the usual way. Following subsequently the usual practice, both the samples were applied on separate filter papers (Whatman No. 1) in equal quantities. Presence of the amino acids was indicated on two-dimensional paper chromatograms, using phenol-water and n-butanol-acetic acid-water (4:1:1) as the developing solvents. The spots were made visible by spraying the papers with 0.1% ninhydrin solution in n-butanol. Intensities of the spots were judged visually.

Little qualitative and quantitative differences were noted in the amino acid contents of the two materials. Among the predominant ones present in both were aspartic acid, glutamic acid, lysine, serine, glycine,  $\alpha$ -alanine and leucine. Threonine, glutamine, valine and proline were of comparatively low intensities and present in both. Four spots could not be identified, of which 2 were of fairly good intensity; one such prominent unidentified spot was present in vegetative mycelia, being absent in the rhizomorphs. Its  $R_F$  value was .09 for phenol-water and 0.14 for butanol acetic acid-water. The colour was blue.

## 22. Effect of Boron on Mango Necrosis.

S. N. DASGUPTA and C. SEN, Lucknow.

The present paper deals with the effect of Boron on mango necrosis. The experiments were carried out in an orchard well-known for heavy incidence of necrosis. Five, ten and fifteen fully blooming trees were sprayed twice with 6 lbs. of borax per 100 gallons of water and once with 6 lbs. of borax per 100 gallons once and 8 lbs. of borax per 100 gallons respectively, and an equal number of trees were kept under observation as controls.

A fruit count was made and it was found that among the test plants out of a total of 3953 fruits only 179 became necrotic with the total percentage of disease only 4.53% while among the controls out of a total of 2843 fruits as many as 898 became necrotic with the total percentage of disease 31.48%.

The results of the experiments were corroborated by statistical analysis which showed (a) that there is a definite preventive effect of borax on mango necrosis, (b) that the degree of air pollution affects the degree of necrosis, (c) that spraying twice is in no way advantageous over spraying once in preventing necrosis, and (d) the efficacy of borax remains stationary as the pollution of air increases, thus increasing necrosis.

## 23. Influence of soil temperature on stem-rot disease of Coriander caused by *Sclerotinia sclerotiorum* (Lib.) de Bary.

J. S. GUPTA, Agra.

Investigations were carried out to see the influence of soil temperature on the stem-rot disease of *Coriandrum sativum* Linn. caused by *Sclerotinia sclerotiorum* (Lib.) de Bary. Seeds were sown in sterile field soil contained in aluminium tumblers under glass house conditions during November 1955–February 1956. At 8-10 leaf stage of the plants the tumblers were transferred to four temperature tanks maintaining temperatures of 19°C ( $\pm 1$ ), 24°C ( $\pm 1$ ), 29°C ( $\pm 1$ ) and 34°C ( $\pm 1$ ) respectively. The upper layer of the soil was inoculated with the fungus mycelium previously grown on corn-sand medium. Six replications of the tumblers, each containing 3 plants, were used and the entire experiment repeated. Necessary controls were kept.

The results indicate that ultimate percentage mortality was 100 at 19°C and 24°C, but the death rate was slower in the latter condition. In 29°C and 34°C soil-temperature, the disease did not occur, but yellowing of the host due to high temperature was observed at 34°C. At 29°C there was no adverse effect on the host. The optimum soil-temperature range for disease development is in agreement with the range for the growth of the pathogen under cultural conditions as reported by Mündkur (1934).

**24. Estimation of sugar and starch in healthy and diseased fruits of Coriander attacked by *Protomyces macrosporus* Ung.**

J. S. GUPTA, Agra.

Earlier chromatographic detection (Gupta, 1954) of certain sugars in healthy and diseased fruits of *Coriandrum sativum* L. infected by *Protomyces macrosporus* Ung. indicated the presence of glucose, fructose, sucrose and one unidentified sugar in healthy fruits and diseased fruits showed the 'spots' for glucose alone. Quantitative estimation of sugars and starch carried out in the present investigation, employing Munson and Walker's method, revealed that in diseased fruits total and reducing sugars are lowered by 1.63% and 0.40% respectively, while invertible sugars and starch are completely absent in comparison to healthy fruits.

**25. A new species of Chytridium from Lucknow.**

R. JOHN (Miss), Lucknow.

This paper deals with the life history of a species of Chytridium parasitic in *Closterium* sps. which was collected from a local tank. The different developmental stages of the fungus were studied by preparing hanging drop cultures which were examined at definite intervals and also by examining fresh material from the tank everyday. The development of the zoosporangium, the liberation of the zoospores and the nature of the resting spores are given in this paper.

A comparison of the present fungus was made with the existing species of Chytridium as classified by Sparrow and Miss Whiffen and it was found that the present form differs from all the known forms in the size and shape of its sporangia, rhizoids, apophyses and resting spores. Therefore this fungus is provisionally identified as a new species of Chytridium.

**26. The role of Osmotic concentration of the substratum in the evolutionary Morphogenesis of Fungi with special reference to the development of Conidium.**

S. K. MAJUMDER, Mysore.

In the evolutionary process fungi belonging to the same nutritional group have undergone the morphological changes in response to the ecological condition of the substratum. This adaptive transformation of the morphology of the organisms has given rise to the different forms of structures at various stages in the process of evolution even in the development of conidium in the saprophytes, the so-called moulds. The evolutionary changes in the physiological aspect of the moulds belonging to the Mucorales and Moniliales have been discussed. The morphological relationship with the members of nutritionally similar group of fungi has been correlated with the ecological condition and has been treated in the evolutionary scale. The comparative osmotic condition in the cells of *Mucor*, *Rhizopus*, *Cunninghamella*, *Trichoderma*, *Verticillium*, *Penicillium* and *Aspergillus* and the conidial transformation has been elaborated on the basis of ecological adaptations. The theory on the evolution of the conidial forms has been elucidated on the basis of the experimental findings. It has also been discussed that in the scale of evolution the morphological adaptations were possibly synchronous with the physiological adaptations in the saprophytic conidial forms of moulds.

**27. The Myxomycetes of the Mussoorie Hills—IV.**

G. W. MARTIN, K. S. THIND and H. S. SOHI, Amritsar.

Three new species of Myxomycetes collected from the Mussoorie hills during August, 1952, are described in this paper: 1. *Stemonitis mussooriensis* sp. nov. is closely allied to *Stemonitis webberi* Rex but is easily differentiated and characterised by the very much shorter sporangia (up to 1.8 mm. tall against 5–15 mm. sporangial height of *S. webberi*), very much larger spores (10.5–12.3  $\mu$  against 8.9  $\mu$  spore size of *S. webberi*) with more conspicuous markings. 2. *Tubifera papillata* sp. nov. outwardly resembles *Tubifera microsperma* (Berk. & Court.) G. W. Martin from which it is differentiated by its larger and uniformly papillate spores. No other species of *Tubifera* is reported to possess this papillate feature of spores. 3. *Lamproderma* species (sp. nov.) which has not been named as yet. It is different from all the reported species of *Lamproderma* in its very short orange coloured stipe, very short columella, rigid and dark capillitium with pale tips, and coarsely and sparsely verrucose spores (9–11  $\mu$  in diameter including the warts).

**28. Ultraviolet induced morphological and cultural mutations in *P. notatum*.**

A. K. MISHRA and P. NANDI, Calcutta.

Conidia of a strain of *P. notatum* were irradiated with ultraviolet rays emitting from a Phillips Germicidal lamp whose 85 per cent of the radiant energy was in the region of 2537Å. The plating was done in Czapek-Dox agar medium after proper dilutions. Colonies appearing from irradiated spores were picked up at random, transferred to Czapek-Dox agar slants and incubated for 10 days, after which they were examined for morphological and cultural differences. Out of the 250 strains examined, 164 proved to be mutants, behaving differently from the parent in morphology and penicillin production.

Mutants were found to have changed in growth rate, colour of the spores, texture of the colonies, pigment and antibiotic production.

Six different types of biochemical and cultural responses were observed among the 164 strains.

Out of the 57 strains which were morphologically changed, 18 produced same amount of penicillin as parent, 32 produced less penicillin and 7 produced no penicillin.

Out of the 107 strains which were unaltered morphologically 15 produced more penicillin, 86 produced less penicillin and 6 produced no penicillin. The course of biosynthesis of any compound can now be studied by considering the gene-enzyme blocks which may occur at varying steps in the course of biosynthesis by an organism. The loss of certain property in mutants can be explained on the basis of a loss of a specific enzyme which controls the reaction concerned.

**29. Cercospora Leaf Spot of Lettuce.**

B. PADHI, Cuttack.

A leaf spot disease has been observed on a variety of head lettuce, *Lactuca sativa* L. grown last winter in a garden at Cuttack of Orissa State. The disease appeared about the middle of February 1956 and caused severe damage to the salad crop in the late growing season. The amphigenous greyish brown spots, upto ordinarily 5 mm. across, are more abundant on outer and older leaves than

on inner younger leaves. Spots do not develop on the youngest heart leaves of the plants. The spots start as water soaked pin heads but as they grow in size a white or bleached necrotic centre about 2 mm. in diameter develops at the infection site. The spots are more or less round but often coalesce and irregular scorched areas result. The conidiophores are caespitose, unbranched, geniculate, few septate 51-100-154  $\mu$  long, about 5  $\mu$  broad and slightly brown in colour. The conidia are apical, acicular, curved, base broader rounded. 102-142-192  $\mu$  long, about 3  $\mu$  broad at base, 11-16-22 celled, hyaline in colour.

The fungus pathogen though, differs in conidium and conidiophore measurements, has been identified as *Cercospora longissima* Sacc. which has been reported on lettuce from Italy and U.S.A. It is hereby recorded for the first time in India.

### 30. Dry rot of Banana.

J. N. RAI, Lucknow.

The paper deals with an internal dry rot of Bauana fruits, a disease hitherto unrecorded. A preliminary survey revealed that the disease was of rare occurrence. The symptoms of the disease have been described in detail. The affected fruits are fresh and healthy in their external appearance and the disease becomes apparent only when they are cut in two halves. In advanced stage of the disease, due to death and disintegration of the cells an irregular cavity running almost throughout the length of the fruit is formed. The tissue lining the cavity is dry, hard and brown in colour and retains this character even after the ripening of the fruit. Histopathological studies revealed the presence of copious fungus mycelium in the diseased tissue.

A species of *Fusarium* was constantly associated with the disease and later pathogenicity tests proved this fungus to be the causal organism.

The symptoms of the disease, the presence of only few diseased fruits in a healthy bunch as also the preliminary study of the morphology of the causal organism indicate that this disease is not related to the Panama disease caused by *Fusarium oxysporum cubense*.

### 31. Seed borne Fungi of Paddy *Oryza sativa* L. in Hyderabad State.

V. RAVINDRANATH and SYED VAHEEDUDDIN, Hyderabad.

During the period of one year about 353 paddy samples were examined from different paddy growing districts. Thirty seeds from each suspected sample were plated in three batches of ten seeds each and kept for incubation. No distinction was made between ectophytic and endophytic fungi. The fungal growth was observed from the third day. The different fungi were transferred into separate culture tubes for identification and pure culture purposes. The fungi were identified on the basis of spore characters and spore bearing bodies. The data revealed that *Curvularia* sp. were very prevalent in the majority of samples closely followed by *Helminthosporium* sp. *Fusarium* sp. *Alternaria* sp. The molds—*Rhizopus* sp. *Aspergillus* sp. and *Penicillium* sp.—were also frequently found in that order of frequency. The symptoms on the seeds in majority of cases, suggested the presence of *Curvularia* sp. The field data collected indicated that there was no correlation between the occurrence of the disease in the vegetative portions of the plant and the symptoms on the seeds.

**32. Cultural Studies of a Sector Variant of *Rhizoctonia solani* Kuhn.**

R. Y. ROY, Banaras.

Two sectors were observed by the author in a pure culture of *Rhizoctonia solani* kuhn isolated from sea-kale (*Crambe maritima*). A study of the two sectors from the point of view of growth, colour etc. showed them no different from each other. Therefore a comparative study of one of the sectors with that of the parent culture was undertaken from the following points of view:—

(a) Diameter of hypha; (b) sclerotial formation; (c) colour of the medium after one month's growth of the fungus; (d) linear growth of colony on 2 per cent malt-extract agar at 25°C. (e) linear growth of the colony on 2 per cent malt-extract agar at temperatures ranging from 10°C. to 35°C.; (f) linear growth of the colony in different media, e.g., Potato-dextrose agar, Dox's agar, Brown's agar etc. at 25°C.; (g) pathogenicity on host.

It was found that the sector varied from the parent in all respects excepting in (a) and (g).

**33. Malformations on some species of *Ipomoea* due to *Cystopus*.**

A. C. SAHGAL, Naini Tal.

*Cystopus ipomoeae pandurateae* (Schw) Stevens and Swingle caused hypertrophies and malignant tumours on *Ipomoea pesligridis*, *Ipomoea pilosa* and *Ipomoea hederacea* at Allahabad. On *Ipomoea pestigridis*, severe infection caused tumour formation on all parts of the host including roots. Abnormal formations on flowers and leaves were very common. Floral organs were heavily malformed and their symmetry was disturbed. Infected leaves bore hypertrophies on leaf-lobes and petioles. The number of leaf-lobes gradually diminished till they were entirely transformed into flattened hypertrophies. On *Ipomoea pilosa*, rough and papillate galls of various shapes were noticed. A section of the green hypertrophy of relatively advanced age showed abundant oospores closely packed together. On *Ipomoea hederacea* hypertrophies were in the form of uniform thickening of the affected region. Floral organs were completely hypertrophied, stems were swollen 4-5 times the normal diameter, petiole got dwarfed, leaves became crumpled and puckered. Mid and lateral veins of the affected leaves were thickened. It is important to note that these hypertrophies did not contain oospores as in the other species of *Ipomoea* but rather abounded in hyphae which reached up to the xylem vessels and were found in the pith as well.

**34. A contribution to the knowledge of Indian *Penicillia*.**

S. B. SAKSENA and M. A. DHORE, Sagar.

A systematic study of all the known species of *Penicillium* collected from Sagar has been made. In all seven isolates were studied. Isolations were made from various sources such as numerous soil samples, laboratory air and a variety of organic substrata. The following species were studied: *Penicillium claviforme*, *P. cycloptum*, *P. funiculosum*, *P. lilacinum*, *P. nigricans* and *P. terlikowskii*.

Out of the above recorded species, *Penicillium claviforme* and *Penicillium cycloptum* are recorded and described for the first time from India. *Penicillium claviforme* is a characteristic member of the genus. Raper and Thom (1949) referred it as uncommon in nature for only a few original isolations have been reported. However, during the studies the present isolate was collected several times from various rotting fruits such as pomegranate, orange, grapes, banana, etc. *Penicillium cycloptum* was isolated from a rotting fruit of *Aegle marmelos*.

The *Penicillia* found in the locality are few in number showing that the genus is comparatively poorly represented in this region. This is in accord with the findings of other workers in the tropical countries.

### 35. A contribution to the knowledge of Indian *Aspergilli*.

S. B. SAKSENA and M. A. DHORE, Sagar.

A systematic study of all the known species of *Aspergillus* collected from Sagar has been made. Isolations were made from various sources such as numerous soil samples, laboratory air, and a variety of organic substrata. In all 31 isolates were studied covering 20 species with a number of strains in some of them. The species studied are : *Aspergillus candidus*, *A. flavipes*, *A. flavus*, *A. fumigatus*, *A. luchensis*, *A. nidulans*, *A. niger*, *A. niveus*, *A. phoenicis*, *A. pulverulentus*, *A. ruber*, *A. sclerotiorum*, *A. sulphureus*, *A. sydowi*, *A. tamarit*, *A. terreus*, *A. ustus*, *A. varicolor*, *A. versicolor* and *A. wentii*.

The two species *Aspergillus pulverulentus* and *Aspergillus wentii* are described for the first time from India.

The number of validly described species of *Aspergillus* from India (Mohanty, 1948) was 24 to which 3 were added by Chattopadhyay and Gupta (1954). Saksena and Shetty added 3 more to the list thus making a total of 30. The addition of two more species, viz., *Aspergillus pulverulentus* and *Aspergillus wentii* brings the total of validly described species of *Aspergillus* for India to 32.

### 36. Soil Fungal Flora of two forest communities of Amarkantak, M.P.

P. K. SHETTY, Sagar.

A detailed study of the soil fungal flora of *Shorea robusta* and *Boswellia serrata* community of Amarkantak forest has been made. The vegetation of the two communities is studied in detail.

Soils of both the communities are ferruginous, blackish grey, sandy loam, porous and acidic in reaction. Their moisture content, pH value, organic content, exchangeable calcium, total nitrogen have also been determined.

The fungal species recorded in *Shorea robusta* forest community are : *Abidia butleri*, *Aspergillus niger*, *A. candidus* Str. 2, *A. fumigatus*, *A. versicolor*, *Penicillium funiculosum*, *P. lilacinum*, *P. nigricans*, *Penicillium* sp.-1, *Penicillium* sp.-2, *Cephalosporium* sp., *Pestalozzia* sp., *Trichoderma lignorum*.

The fungal species recorded in *Boswellia serrata* community are *Abidia butleri*, *Aspergillus niger*, *A. candidus* (strain-1), *A. fumigatus*, *A. varicolor*, *Penicillium funiculosum*, *Penicillium* sp.-1, *Penicillium* sp.-2, *Cephalosporium* sp., *Trichothecium roseum*, *Sphaeronema spinella*, *Trichoderma lignorum*.

The photosociological analysis of the fungal flora has also been carried out. Soil on which *Shorea robusta* community stands shows 3,67,000 fungi per gram of soil probably due to its high organic content (14.65 per cent). While *Boswellia serrata* soil shows a comparatively smaller number of fungi (98,000 per gram of soil) and also poor in organic matter. Excepting *Abidia butleri* all species isolated belong to the group Fungi Imperfecti.

*Trichothecium roseum* has been isolated for the first time from Indian soils.

**37. Nitrogen requirements of *Fusarium Coeruleum* (Lib.) Sacc.**

R. N. TANDON and G. P. AGARWAL, Allahabad.

The growth of the two strains of *F. coeruleum* isolated from potato and *Colocasia antiquorum* on different nitrogen compounds has been studied. The two fungi could not grow in the complete absence of nitrogen from the medium. Potassium nitrate supported the best growth of the *Colocasia* strain while acetamide was most suitable for the potato strain. The two fungi could grow on sodium nitrite which supported good growth of the *Colocasia* strain but only poor growth of the potato strain. The poorest growth of the two organisms was on hydrazine hydrochloride. Both the strains of *F. coeruleum* have been placed in Group 2 of the classification proposed by Robbins (1937).

**38. Progress of work of selection of Wheat Resistant to Black Stem Rust of Himayetsagar, Hyderabad State.**

SYED VAHEDUDDIN, D. BAP REDDY and R. BENER RAJ, Hyderabad.

Testing and selection of Wheat varieties resistant to Black Stem Rust, *Puccinia graminis tritici*, was started during 1943-44 and is still in progress. Out of the hundreds of selections made at the Himayetsagar Main Experimental Farm, only three varieties HW.1, HW.2, and HW.3 proved successful. They are highly resistant to rust, and are also good yielders. Their reaction to various physiologic races so far found in Hyderabad is very good. HW.1 is almost resistant to all the races found in Hyderabad i.e., 15, 40, 42, 24, 21, 34 and 75. These varieties are in the district trial stage after which they are to be distributed to the cultivators.

Six promising varieties Hy. 12-5-7 (1), Hy. 11-8 (1), Niphad 4 (1), Ken-26 (1), Kendi (1), K.34 (1), have also been selected at this station which are also resistant to rust and are good yielders compared to other varieties of the State which are susceptible to rust. Their reaction to various physiologic races is also good. They are to be tested further. This work at Himayetsagar station is in progress.

**39. Panama Wilt of Banana on Basrai variety.**

SYED VAHEDUDDIN, D. BAP REDDY and V. RAVINDRANATH, Hyderabad.

The main centres of Banana (*Musa paradisiaca* L.) cultivation are in Parbhani, Aurangabad, Gulbarga and Nizamabad District. Mostly local varieties are grown. A few years ago the dwarf variety Basrai was added into cultivation. It is a heavy yielding one too. In general there was no disease of importance in the state until 1954 when for the first time Panama Wilt, *Fusarium oxysporum* was reported from Rudrur where the entire plantation succumbed to the disease. The variety concerned was Basrai which was reported resistant so far all over India. A survey was undertaken in 1954-56 to investigate into the prevalence of the Wilt in the districts of Parbhani, Aurangabad, Nanded, Gulbarga, Raichur, Osmanabad, Nizamabad, Medak, and Hyderabad covering an area of 2,796 acres. So far Wilt was found present only in Bansawada and Rudrur areas of Nizamabdd District. Wilt effected plants have been eradicated and the appearance of the disease in other areas is being watched.

**40. On the occurrence of some larger fungi from Bihar.**

A. S. YADAV, Patna.

In this paper some forty two larger fungi hitherto unrecorded from Bihar on new hosts have been reported. Notes on habits, habitats and other features of interest have been added.



In case of *Ithyphallus impudicus* Fr. an interesting teratological phenomenon was observed. There came out two stipes bearing a common Gleba from a single fruit body after rupturing the peridium.

#### (v) Lichens

##### 41. On the Indian species of the Lichen Genus *Usnea*.

D. D. AWASTHI, Lucknow.

The genus *Usnea*, which is a conspicuous component of the flora in the temperate and alpine Himalayas and the temperate Nilgherries is fairly well represented in the author's personal herbarium. During the course of the investigations—which are still in progress—the author came across certain interesting specimens which form new reports from India and are included herewith.

Motyka (1936-38), in his monograph of this genus described 451 species from all over the world and reported as many as 37 species from India. Out of the collection with the author, 20 species have so far been identified, of which 12 species are such that are already reported from India in the above monograph, while the remaining 8 species, though reported from other parts of the world are known from India for the first time. These species are : (1) *U. insignis* Mot. (Darjeeling), (2) *U. erubescens* (Stein) Mot. (S. Indja, Kodaikanal), (3) *U. Cornea* Mot. (Himalayas), (4) *U. diademensis* Vain (Himalayas), (5) *U. livida* Mot. (Darjeeling), (6) *U. Hossei* Vain (Bihar), (7) *U. subscabrosa* Nyl (Kodaikanal) and (8) *U. undulata* Stirt (Kumaon).

Thus after the addition of these 8 species the total number of *Usnea* species reported from India is raised to 45, while with the completion of the work on all specimens it is hoped that the number may rise again.

##### 42. *Usnea nepalensis* Awasthi—a new species from E. Nepal.

D. D. AWASTHI, Lucknow.

While working on the *Usnea* specimens collected by the author from E. Nepal in May-June 1953, a certain specimen did not tally with the descriptions of the species recorded in the monograph of this genus by Motyka. This specimen was subsequently verified to be a new species and has been named as *Usnea nepalensis* Awasthi sp. nov. It comes under the section *Setulosae* Mot. and is characterised by the rigid, caespitose greyish to reddish grey thallus which is minutely scabrid and white papillate (sorediate) and shows affinity to *U. Pangiana* Stirt. and *U. rubicunda* Stirt. but differs in the colour of the thallus which is intermediate between the two and in KOH and iodine reactions which respectively are :—Cortex K+ reddish ; and central axis I+reddish.

This new species raises the total number of species of this genus known from India to 46.

#### (vi) Bryophyta

##### 43. Life history of *Barbula Indica* Bridel.

I. BANERJI and SUBIR SEN, Calcutta.

Life history of *Barbula indica* Bridel belonging to the family *Pottiaceae* has been studied in detail. This preliminary report includes the morphological and anatomical studies of the gametophore, developmental studies of the sex organs, embryo and sporogonium. Different modes of regeneration of the gametophore have been described. Study of meiosis reveals the presence of 15 bivalent chromo-

somes in the spore mother cells. Presence of a heteromorphic pair of chromosome has been clearly observed. Disjunction of the bivalents are fairly normal, though irregularities caused by non-disjunction of the bivalents resulting into distribution of unequal number of chromosomes at the two poles during first anaphase are not of infrequent occurrence. Spore germination and development of gametophore bud has been studied. The protonema are characteristic in this species with vertical transverse walls.

The difficulties in classification of the mosses, as such, phylogenetically, have been discussed and the necessity for a detailed study of the life history of the different species of moss reported to be present in India is stressed from the systematic and other points of view.

#### 44. Sporeling germination in *Plagiochasma intermedium* Lindenb & Gottsche.

NARINDER CHOPRA, Lucknow.

The mature sporogonia for the purpose of spore germination were collected on 10th August 1956 from Residency.

The reticulate spores measuring  $60-75\mu$  across its diameter were sown on tap water on 13th August. The spores germinated on 23rd August. The endospore grows out from the side of the triradiate mark into a green tube. Part of the contents of the spore pass into the germ tube. After a week of its germination a plate of four cells is formed at the apex of the germ tube. The first rhizoid arises from the germ plate.

#### 45. Sporeling germination in three Lucknow Mosses.

NARINDER CHOPRA, Lucknow.

For the purpose of spore germination mature capsules were collected in paper packets on 5th October 1955.

*Tortula* sp.: The spores sown on Knop's solution,  $\frac{1}{2}$  the normal strength germinated into the protonema without any rest period. The protonema fragments, each fragment develops into a fresh protonema.

The terminal cells of the protonema transferred on soil, formed thick walled gemmae which get detached and germinate into a fresh protonema without any rest period.

The development of the bud and gametophore is like that in *Funaria hygrometrica* Hedw (Brown 1919).

*Pottia* sp.: The spores sown on Knop's solution,  $\frac{1}{2}$  the normal strength germinated into filamentous protonema.

The development of the gametophore on the protonema transferred on soil, is as that in *Funaria hygrometrica* Hedw (Brown 1919) & *Rhodobryum roseum* (Chopra unpublished) and *Tortula* sp. noted above.

The terminal cells of the protonema kept in the nutrient solution formed gemmae.

*Mnium* sp.: The spores sown on Knop's solution,  $\frac{1}{2}$  the normal strength germinated into the protonema which fragments, each fragment develops into a fresh protonema as in *Tortula* sp. noted above.

**46. Regeneration studies in three Lucknow Mosses.**

NARINDER CHOPRA, Lucknow.

Leafy stems, defoliated stems, leaves and portions of the seta of the three mosses i.e. *Physcometrellopsis indica* Dixon, *Tortula* sp. and *Pottia* sp. under study were placed on some of the following media : Knop's solution,  $\frac{1}{2}$  the normal strength sterilized tap water, chemically pure sand, sterilized soil collected from the natural home of the plants and moist filter paper

1. *Physcometrellopsis indica* Dixon : In 2-5 days the cells of the midrib gave out protonemal filaments on the tap water but profuse growth occurs on the Knop's solution.

2. *Pottia* sp. : Only defoliated stems produced gametophores on sterilized tap water. In this process any superficial cell projects above its sister cells and soon becomes very rich in cytoplasm. Later three intersecting oblique walls are laid down in this cell and cut off an apical cell which continues to grow. No leaves are produced from the first few segments but little later imperfect leaves are produced which surround the young apical cell. Ultimately a normal gametophore is established.

3. *Tortula* sp. : Only defoliated stem produced protonemal filaments on the liquid medium but on soil gametophores developed. The gametophore develops in the same way as in *Pottia* sp.

**47. Sporeling germination in *Notothylas Indica* Kash.**

S. K. PANDE and NARINDER CHOPRA, Lucknow.

The mature sporogonia were collected (September 20, 1955) from the compound of the Residency and sown on 6th October 1955, on sterilized tap water, Knop's solution, normal and  $\frac{1}{2}$  the normal strength but germination was not successful, probably due to the fact that the spores need resting period. Fresh cultures from the same collection were tried in July 1956. After 10 days the spore becomes transparent showing a prominent nucleus. Five days later (i.e. a fortnight after sowing) endo-spore emerged out as a short papilla and partly the spore contents migrate into the papilla. First rhizoid arises near the junction of the spore and the papilla and is devoid of chloroplasts. The rhizoid is separated by a septum from the cell bearing it. The papilla remains very short and at a very early stage two oblique walls are laid down in it establishing an apical cell in the short and broad germ tube. The apical cell cut off a number of segments and becomes multicellular. Further study is in progress.

**48. Cyto-embryology of *Physcometrellopsis indica* (Dixon).**

S. K. PANDE and NARINDER CHOPRA, Lucknow.

*Physcometrellopsis indica* (Dixon) grows luxuriantly in and around Lucknow in patches during winter (November-March).

The species is monoecious. The male and female heads are borne on the same shoot, the former lying slightly below the latter.

The germination of the spore in the laboratory on Knop's solution,  $\frac{1}{2}$  the normal strength, and sterilized tap water was tried. In the former the germination commences after 8 days whereas in tap water it starts after 12 days. The protonema is filamentous and normal. The shape of the apical cell and its segmentation resembles that of *Funaria hygrometrica* Hedw. and *Rhodobryum roseum* Limpr. Chopra (unpublished).

The first antheridium does not arise from the apical cell but from its segments. Its development is, on the whole, similar to that of *Funaria hygrometrica* and *Rhodobryum roseum*. The first few archegonia arise from the segments of the apical cell but ultimately the apical cell itself is used up and produces the last archegonium.

The fertilized egg divides transversely into epi-basal and hypo-basal segments. This division is generally followed by an oblique wall in the epi-basal cell and later on the hypo-basal cell also divides in the same fashion. Sometimes, however, the oblique walls in both the epi-basal and hypo-basal segments are laid down simultaneously. The cell division and growth in the epi-basal half of the embryo is regular and quick while in the lower half the process proceeds slowly and irregularly. The hypo-basal half ultimately forms the foot and a part of the seta while the epi-basal half differentiates into the capsule and upper part of the seta. The development of the capsule closely corresponds to that of *Funaria hygrometrica*. The peristomal teeth are absent and the operculum falls off as a lid by the disintegration of epiphragm layer to shed off the spores.

At diakinesis in acetocarmine capsule squash 31 bivalents could be counted. The wall formation in the tetrad is simultaneous. Meiosis is normal.

#### 49. On a new species of *Riccia* from Mt. Abu, Rajasthan.

S. K. PANDE and RAM UDAR, Lucknow.

An examination of a hepatic collection from Mt. Abu, kindly placed at the disposal of Pande by Dr. K. M. Gupta, revealed the presence of specimens of a *Riccia* which differs markedly from all the known species of the genus and deserves the status of a new species.

The plants are monoecious, bluish green, small, 2.5 mm. in maximum length, about 1—1.5 mm. broad, deeply sulcate anteriorly and less so posteriorly, wings sharply acute, scales large, overlapping, deep violet, spores 80-100  $\mu$  along the maximum diameter, winged, only 3-4 large reticulations across the outer face, rarely 5, incomplete on the inner faces, triradiate mark very conspicuous, wings 6-8  $\mu$  wide, wing margin broadly wavy.

#### 50. On the Hepatic Flora of Nepal.

S. K. PANDE and RAM UDAR, Lucknow.

The present note is the result of a preliminary study of a collection of Hepatics from Nepal by Sykes, Stainton, Williams and Polouin during 1949-54 under the aegis of the British Museum (Natural History) London was sent by Dr. G. Taylor, the Keeper of Botany, to one of us (Pande) for investigation. This collection runs to about 200 packets and is a representative one for the territory covered as it extends upto a high altitude range of 15,000 ft. Our previous knowledge of the hepatic flora of Nepal is mainly due to Stephani (1900-24) according to whom 62 species distributed over 30 genera occur in this territory. The same species have also been listed by Chopra (1943) in the "Census of the Indian Hepatics".

Our study of the collection revealed the presence of several genera and species not included in any of the publications on the Bryology of Nepal. A few of the species show morphological features of unusual interest.

The following is a tentative list of liverworts identified :—

- \*1. *Anthoceros* sp. I. \*2. *Anthoceros* sp. II. \*3. *Marchantia polymorpha*.  
4. *Marchantia nepalensis*. \*5. *Marchantia palmata*. 6. *Marchantia nitida*. \*\*7. *Preissia*

sp. \*8. *Conocephalum conicum*, 9. *Dumortiera* sp. \*\*10. *Reboulia hemispherica*. \*11. *Asterella angusta*. \*12. *Asterella reticulata*. \*13. *Asterella mussooriensis*. 14. *Plagiochasma appendiculatum*. \*\*14a. *Athalamia pinguis*. \*\*15. *Sauteria alpina*. \*16. *Riccia natans*. 17. *Pellia calycina*. \*\*18. *Calycularia crispula*. \*\*19. *Blasia pusilla*. 20. *Riccardia* sp. 21. *Herberta* sp. 22. *Bazzania* sp. \*\*23. *Cephalozia* sp. 24. *Cheiloscyphus* sp. 25. *Jungermannia* sp. *Nardia* sp. 26. *Plagiochila* sp. \*\*27. *Scapania* sp. 28. *Porella* sp. 29. *Radula* sp. 30. *Frullania* sp. \*31. *Thysananthus*.

In the above list, the plants marked (\*) and those marked (\*\*) are the species and the genera respectively new to the flora of Nepal.

### (vii) Pteridophyta

#### 51. Stelar anatomy of Indian Aspleniaceae.

S. S. BIR, Amritsar.

Stelar anatomy of 11 species of the genus *Asplenium* L. namely *A. dalhousie*, Hook., *A. varians* HK—Grev., *A. trichomanes* L., *A. exiguum* Bedd., *A. ensiforme* Wall, *A. planicaule* Wall. ex.Hook., *A. laciniatum* Don. var. *sub-integrifolia* Hook., *A. tenuifolium* Don., *A. normale* Don., *A. cheilosorum* Kunze, and *A. unilaterale* Lamk., has been investigated. These were collected from Eastern and Western Himalayas between 4,000—8,000 ft. altitudes. In all cases the structure is dictyostelic with usually 2—5 cauline meristemes depending on size of the rhizome and number of leaf bases present. Normally the disintegration of central stele is caused only by leaf gaps. As a rule a 'basal' root trace departs just before the opening of leaf gap in all the species except three epiphytic ones namely *A. ensiforme*, *A. planicaule* and *A. laciniatum* var. *sub-integrifolia*. In these the basal root trace gets slightly shifted upwards and detaches just after the opening of leaf gap from one of the meristemes. This is possibly associated with their epiphytic habit. The basal root trace may or may not divide during its outward course in the cortex. Additional root traces are also given off from lateral faces of meristemes enclosing the leaf gaps in some species. In the basal portion of the rhizome of the epiphyte *A. ensiforme*, a few simple perforations are present on the host side. The perforations are similar to leaf gaps, opening in the same way except that the leaf traces are absent.

The leaf trace is binary and two equal foliar strands get detached from margins of the meristemes enclosing the leaf gap, at the same or different levels. These unite higher up in the rachis to form one bundle with x-shaped xylem. The pinna trace is marginal in all the species. The xylem in the meristeme as well as leaf strand is solid and there is no admixture of xylem parenchyma. Unitary leaf trace with two xylem patches is noticed only in *A. trichomanes* and *A. varians*. The two xylem patches in these, however, get detached from different meristemes thus confirming that unitary leaf trace is a modification of the binary one, an adaptation to the small size of the rhizome. The root is diarch in all the cases.

The basic plan of rhizome structure in *Asplenium* resembles that of *Blechnum*. The presence and origin of perforations observed in the basal region of *A. ensiforme* resembles that seen in *Stenochlaena palustris* (Mehra and Chopra, 1951). It is concluded that these anatomical comparisons give good support to the natural affinities of Asplenoid and Blechnoid Ferns. The relationship of *Asplenium* with allied genera of this family and with members of Dryopteridaceae (Bower, 1923) and Davalliaceae is brought out.

**52. On an epiphytic species of *Nephrolepis*—*Nephrolepis paucifrondosa* d'Almeida.**

T. S. MAHABALE and S. R. JAVALGEKAR, Poona.

This species is generally epiphytic at Khandala but occasionally is also found in the caves at Panchghani. The structure and life-history of it were investigated which showed that :—

It is a tuberiferous species like *N. cordifolia* Baker, but the development of the tubers in it differs in some details from that in *N. cordifolia*. The plant generally produces a single leaf but sometimes 2 or 3 in a season. The species propagates mostly by means of these tubers, left in the debris gathered in the crevices of tall trees. New plants arise from them next year.

The root is generally diarch. The stem is dictyostelic. The leaf-trace consists of three meristemes. The anatomy of the leaf shows the shade-loving and epiphytic nature of the plant in thick forests.

The anatomy of the tuber is similar to that in *N. cordifolia* and other species described by Sahni (1914 and 1915). The mature tubers, however, have about 15-20 meristemes. The reverse changes in the anatomy of a tuber, as it germinates were studied. The stem forms a prostele at the base for about  $\frac{1}{2}$  cm. and then breaks into a dictyostele through a siphonostele rather abruptly.

A study of the sporogenesis showed that there are 28 chromosomes as in *N. exaltata* Schott. The spores germinate readily and form delicate, green, cordate, hermaphrodite prothalli.

From all these features it is obvious that the species is highly modified to lead its precarious existence as an epiphyte in deep forests.

**53. A note on *Aleuritopteris grisea* (Blandford) Panigrahi Comb. nov. and *A. anceps* (Blandford) Panigrahi comb. nov.**

G. PANIGRAHI, Shillong.

"The Silver Ferns" of Asia and Africa are generally attributed by taxonomists to *Cheilanthes farinosa* (Forsk) Kaulf. However, the genus, *Cheilanthes* Sw (Swartz, Synop. Filicum, 1806, 5, 126) is based on the type species *Cheilanthes micropteris* Sw., whereas the genus, *Aleuritopteris* Fée (Genera Filicum, 1850-'52, 153, Pl. 12B, f. 1, 2) is founded on the type species, *Pteris farinosa* Forsk (Fl. Aegypt. Arab, 187, 1775.). Therefore, on the authority of the 'Type Method', the plants belonging to *Pteris farinosa* Forsk should strictly be attributed to *Aleuritopteris* Fée rather than to *Cheilanthes* Sw.

However, evidences from various lines of study are available to suggest (cf. Panigrahi, Proc. Nat. Inst. Science India. 21B, 143, 1955) that within the scope of *A. farinosa* (Forsk) Fée, Complex, at least three taxonomic species must be recognised, two of which are new combinations, as proposed below.

1. *Aleuritopteris grisea* (Blandford) Panigrahi, comb. nov.

Basynym :—*Cheilanthes grisea* Blandford. "The Silver Ferns of Simla and their allies". Calcutta, 1886.

Synonym :—*Cheilanthes farinosa* (Forsk) Kaulf. Enum. Fil. 212. 1824.

*A. farinosa* var. *grisea* (Blandford) Ching. The Hong Kong Naturalist, 194, 1941.

2. *Aleuritopteris anceps* (Blandford) Panigrahi, comb. nov.

Basynym :—*Cheilanthes anceps* Blandford. "The Silver Ferns of Simla and their allies". Calcutta. 1886.

Synonym :— { *C. farinosa* (Forsk) Kaulf. (Ref. as in 1 above).  
*A. farinosa* var. *anceps* (Blandford) Ching.

(Ref. as in 1 above).

**54. Genome analysis in *Cyclosorus parasiticus* complex.**

G. PANIGRAHI, Shillong.

Morphological characters together with the cytological behaviour of the parents and the artificial hybrids involving one diploid species and five other related tetraploids belonging to *Cyclosorus parasiticus* complex have been studied. It appears that the diploid species, *C. repandulus* (v. A. v. R.) Ching from Ceylon, which, as a relict, is very much localised in its distribution, is a common parent to each one of the five other amphidiploid species, which, however, are extensively wide-spread. This and other available evidences suggest that *C. repandulus* was probably more abundant at one time to come in effective contact with a number of other unknown diploid species of *Cyclosorus* so to produce these amphidiploid species.

However, a probable estimate of the minimum number of these unknown diploid species can be based on the evidences of homology of chromosomes in the F<sub>1</sub> species hybrids (cf. Panigrahi, Proc. Ind. Sci. Cong. 1955). If 'A', 'B', 'C', 'D', each represents a haploid chromosome set,  $n=36$ , we have to postulate, at least, four diploid (viz. AA, BB, CC, DD) species (*C. repandulus* being represented by AA) to account for the synthesis of the five amphidiploids of the present day, assuming, however, that the original 'A' genome might have undergone mutations to produce genomes of varying degrees of homology with the 'A' set. It further suggests that the morphological characters of the amphidiploid species may have been determined by the respective diploid ancestors other than AA.

**55. Spore-formation in *Adiantum peruvianum* Klotz.**

R. P. ROY and BAXI M. B. SINHA, Patna.

It was pointed out earlier (Roy and Sinha, 1956) that the species *Adiantum peruvianum* Klotz. shows meiotic irregularities with the result that the spores that are formed are of two types. Some are shrunken and shrivelled up and others, well-developed and round. The origin of the two types of spores have now been traced. In the same sporangium, different spore mother cells show variations in their behaviour. In some the bivalents arrange at the equator but fail to separate and consequently are included in the same nucleus. In others there are several univalents at metaphase and these are not distributed equally between the resulting two daughter nuclei. Consequently at the telophase one daughter nucleus gets very few chromosomes and other many more. Such misdivision would obviously give rise to different types of spores. Then only two spores with double the usual number of chromosomes are formed from the spore-mother cell in which the chromosome could not separate after first metaphase of meiosis and were included in the nucleus. As a result of these variations in the behaviour of the different spore-mother cells, different shapes and sizes of spores are formed. These spores have therefore different chromosomal constitution, and behave differently at the time of germination. Some do not germinate at all in Knop's solution and others germinate normally. The prothalli formed are also of various types, from filamentous to well-developed heart-shaped structures.

During the differentiation of the sporogenous cells to form spore mother cells, occasionally misdivision occurs. Such mitotic misdivision results in this formation of cells with double the number of chromosome, i.e. 120 instead of usual number 60. Meiosis in these giant mother cells have already been reported in the paper referred to above. The origin of these giant cells has now been found to be due to misdivision during the differentiation of the spore mother cells from sporogenous cells.

The variation in the structure, shape, germination and other behaviour of the different spores in the species is, therefore, either due to (i) unequal distribution of univalents (ii) non-separation of chromosomes at first anaphase of meiosis resulting in diploid spores or (iii) occasional formation of giant spore mother cells due to mitotic misdivision of the sporogenous cells at the time of their organization into spore mother cells.

Further investigation on this subject is in progress.

### (viii) Gymnosperms

#### 56. On the anatomy of some Conifer seedlings.

(MISS) C. P. GODAVARI, Annamalainagar.

1. Comparative morphological and anatomical studies on the seedling leaf and wood for *Pinus patula*, *Thuja orientalis*, *Podocarpus gracilior*, *Araucaria bidwillii* and *Agathis brownii* were done.

2. When morphologically considered the seedlings of *Thuja orientalis* alone differ markedly from the adult in having linear and spreading leaves.

3. In all the five species investigated, the seedling wood displays only uniseriate pitting.

4. In the case of *Araucaria bidwillii* and *Agathis brownii*, the bordered pits tend to become contiguous in the later formed tracheids paving the way for multiserial pitting.

5. From the above study, it is obvious that the multiserial pitting is secondarily a derived condition from the uniseriate pitting.

6. Similar observations in respect of radial pitting were made by Jeffrey for *Agathis australis*. The above observations with regard to the radial pitting confirm Jeffrey's work on *Agathis australis*.

#### 57. Embryogeny of *Gnetum ula* Brongn.

P. N. MEHRA and RAJESHWAR KUMAR, Amritsar.

Mehra and Rai have already studied the embryology of *Gnetum ula* upto the formation of pro-embryo. Later part of the life-cycle covering up the embryogeny is presented in this paper.

The pro-embryo of *G. ula* is many celled. Each cell follows an independent course and elongates into a suspensor like structure—the pro-embryonal tube.

Pro-embryonal tubes are uninucleate. Its nucleus divides and of the two nuclei so formed, the smaller one gets organised into a wall-less endogenous embryonal cell which is pyriform but more commonly club-shaped. This cell is attached to the tip of the tube which is now designated as the prosuspensor.

Prosuspensor contains a single nucleus and no cross walls are formed in it. Branching of the tubes is very rare.

Further stages in the development of embryo occur when the seed has detached from the parent plant. These have been secured mostly from the whole mount dissected embryos stained in acetocarmine, supplemented in later stages of embryogeny through paraffin sectioned material.

The club shaped embryonal cell gradually becomes spherical and divides into two by a transverse, vertical or oblique wall. Later divisions are irregular and result in the formation of a multicellular embryonal mass. Upper cells of this mass elongate and form embryonal tubes. Cells in the lower region of the ovoid



mass form the meristematic embryonic body. The secondary suspensor constituted by the embryonal tubes is a highly elongated tortuous structure.

The mature embryo differentiates itself into shoot apex, two cotyledons and the root cap. Later, a feeder is formed as a lateral growth from the hypocotyledonary stem.

Cleavage polyembryony is characteristic of this species. Comparisons have been made with the available accounts of the embryogeny of the other species of the genus and its phylogenetic relationship discussed.

#### (ix) Angiosperms

##### 58. Floral morphology of the male flowers of *Herpetospermum pedunculatum*.

H. L. CHAKRAVARTY and R. K. BASAK, Calcutta.

Floral morphology of the male flowers of *H. pedunculatum* shows the following feature of interest. The number of vascular bundles varies from 7-8 in the pedicel and increases towards the base of the receptacle forming a ring of 20 bundles and ultimately forms a semi-siphonostelic structure at the base of the receptacle. At a higher level 15 bundles are given off for the petals, which alternate in a group of 3 with 5 sepal mains. The bundles of the stamens are traceable in the usual 2-2-1 fashion. Throughout the entire length of the receptacle, the traces for the even pair remains so close to each other that they apparently look like a single bundle. The odd stamen with a single bundle may easily be distinguished by its small size in cross-section. The union of stamen traces for uneven pair can be traced well in the lactic acid treatment of the flower buds. A well developed pistillodium rising from the base of the receptacle, with some weak supplies also present.

##### 59. A contribution to the bibliography of Indian Gramineae.

S. K. JAIN and R. C. BHARADWAJ, Lucknow.

The paper has two parts, first the introductory and second the list of references on Indian Gramineae.

The work was started by the authors when they under the guidance of Mr. M. B. Raizada, Forest Botanist, Dehradun, were engaged in the study of grasses of Upper Gangetic Plains, during 1949-1951. Additions were being made to it constantly and the list has been made up-to-date as far as possible.

The first part gives a brief review of the work on Indian grasses. Reference has been made to the economic uses of grasses and the work being done in various Agricultural, Forest and other Research Institutes on cereals, fodders, paper-pulp, sugarcane and essential oils etc. The lack of proper knowledge of the entire grass flora of India, especially the great confusion in their identity and nomenclature has greatly handicapped satisfactory solution of problems concerned with hybridization of cereals and sugarcane, grasslands, soil conservation and exploitation for fodder, paper pulp, essential oils etc.

The bibliography contains 720 references. General works on taxonomy and nomenclature as well as some books and papers dealing with Indian genera as represented in foreign countries have been included because they have to be constantly referred for purposes of identification, drawing keys, revision of genera, location of types, clarifications of nomenclature, discussion of affinities and assessment of economic value.

**60. Embryology of *Trichodesma amplexicaule*, Roth.**

PUSHPA KHANNA, Jaipur.

The genus *Trichodesma* belongs to the family *Boraginaceae*. It is widely distributed in tropical and warm temperate regions of Asia, Africa and Australia.

*Trichodesma amplexicaule* is widely distributed throughout India from Sind, Rajputana and Central India to Malabar in the South. During the rainy season, it occurs as a weed.

The flower is pentamerous to hexamerous. The floral parts develop in acropetalous order to show no corona.

Microsporogenesis proceeds in the usual way. The tapetum is glandular and its cells become four to seven nucleate. The nuclei may fuse to form one to two amoeboid nuclei. Divisions in the spore mother cell are simultaneous. The mature pollen grain is spherical, shows three germ pores and are shed at the two-nucleate stage. The anatropous ovule is invested with single massive integument traversed by five to eight vascular strands below the epidermis.

The archesporial cell directly functions as the megaspore mother cell. The chalazal megaspore of the linear tetrad functions and gives rise to the embryo sac development of which conforms to the *Polygonum* type. The polar nuclei fuse to form the secondary nucleus prior to triple fusion. The three antipodals are ephemeral.

The endosperm is *Nuclear* to begin with but later becomes cellular and conforms to the *Borago* type of endosperm development.

The zygote divides transversely. The suspensor is formed by the derivatives of the basal cell. Both the basal and the terminal cells contribute to the formation of the embryo. The type of development conforms to the *Asterad* type very nearly to *Polygonum* variation.

The seed is oblong and completely filled with the embryo. The inner wall or the testa is lined by two layers of endosperm. The outer and the inner pericarp layers are cutinised while the middle region is resiniferous.

Abnormalities like polyembryony, exembryonal seed, aggregation of more than two nuclei in the region of the polars and occurrence of two celled archesporium in the ovule have been observed.

**61. Origin and development of axillary buds in *Boehmeria nivea*.**

B. C. KUNDU and N. S. RAO, Barrackpore.

The shoot apex of *Boehmeria nivea* is concave in shape and is sunken below the leaves. The size and shape of the shoot apex vary with the leaf initiation. Four growth zones are distinguished. They are (1) the central mother cells, (2) the peripheral zone, (3) the tissues derived from zone 2, and (4) the central portion of the pith derived from zone 1. Buds develop from the second layer of the leaf primordium. After growing horizontally for some time, they shift to axillary position. Procambium differentiates acropetally. Bud gap does not develop above the departure of the bud trace. The differentiation of both phloem and xylem is acropetal and phloem differentiates earlier than xylem. The zonal pattern, the shape and size of the shoot apex and the leaf bud association are discussed in the light of development.

**62. Embryology of *Jasminum angustifolium* Vahl.**

H. MAHESWARI DEVI, Waltair.

The paper deals with the life history of *Jasminum angustifolium* Vahl belonging to the family *Oleaceae*.

The archesporial cell becomes differentiated just at the time of the differentiation of the 4 lobed contour in the anther. The anther structure shows two wall layers, secretory type of anther tapetum and sporogenous tissue. During further growth of the anther the inner wall becomes crushed and the subepidermal layer divides once periclinally and the derivatives so formed develop into a biseriate fibrous endothecium.

The sporogenous tissue divides in a simultaneous manner, Cytokinesis is by furrowing. Both bilateral and tetrahedral pollen tetrads occur. The mature pollen grains are 3 celled with three or four germ pores.

Exceptional cases of pollen grains with more than 3 nuclei were found in a fairly good number of cases. In some cases there were 4 nuclei, 2 vegetative and 2 generative nuclei, while in other cases there were 6 nuclei, 2 vegetative and 4 sperm nuclei. A few cases of pollen grains with 5 nuclei also were met with. In size also these abnormal pollen grains are larger than the normal ones.

The ovary is bicarpellary syncarpous and two locular with one ovule in each locule on axile placentation. The ovule is anatropous, unitegmic and tenuinucellate.

The archesporium is multicellular and most of the archesporial cells directly function as the megaspore mother cells without cutting off a parietal cell. A linear tetrad of megaspores is formed. The chalazal megaspore is functional and undergoes three successive free nuclear divisions to form an 8-nucleate embryo sac. As most of the archesporial cells are functional a number of embryo sacs are formed. The stages of development in all of them are not uniform and hence the embryo sacs in a ovule are found in different stages. In their disposition also they show some variations. Some cells of the integumentary tapetum enlarge and appear as if they are sporogenous cells. Usually one embryo sac remain functional and the rest degenerate.

Fertilisation is porogamous. Syngamy and triple fusion take place.

Endosperm is of the nuclear type. It later on becomes cellular and is completely absorbed in the mature seed.

The fertilised egg divides transversely and a two celled embryo is formed. The terminal cell *ca* and the basal cell *cb* again divide transversely resulting a four celled linear proembryo. Of the four cells that are formed, the terminal cell *l* and the subterminal cell *l'* contribute to embryo proper and the remaining two cells *m* and *cl* contribute to the development of the suspensor. Thus the embryo development conforms to the Solanad type. In one case two embryos were found developing in the same ovule.

In the mature seed the endosperm is completely consumed and the embryo lies surrounded by the integument.

### 63. Embryological studies in *Voacanga foetida* Rolf.

H. MAHESWARI DEVI, Waltair.

Microsporogenesis and male gametophyte, megasporogenesis and female gametophyte, endosperm and embryo development in *Voacanga foetida* Rolf belonging to the family Apocynaceae are described in detail.

**Microsporogenesis and Malegametophyte :** In the anther lobe the hypodermal archesporium consists of a plate of 6-8 cells in transverse section and 8-10 cells in longitudinal section. The archesporium divides further giving rise to an outer parietal layer of cells and inner sporogenous layer. The former divides a few times in a periclinal manner and gives rise to four wall layers and a tapetal cell layer of secretory type. No fibrous endothecium is differentiated. Division in the pollen mother cells is of simultaneous type. Cytokinesis is by furrowing. Mature pollen grains are two celled, triplicate and tricolpate.

**Megasporogenesis and Female gametophyte:** The ovary contains numerous ovules on axile placentation. The ovules are anatropous, unitegmic and tenuicellate. The archesporium in the ovule consists of a single subepidermal cell which enlarges and directly functions as the megaspore mother cell. A linear tetrad of megaspores is formed. The chalazal megaspore of the tetrad develops into an 8-nucleate embryo sac according to the Polygonum type.

**Multiple Embryo sacs:** A few cases of ovules were met with containing more than one embryo sac.

**Abnormal Embryo sacs:** Abnormal embryo sacs with 6 nuclei were found in a few cases.

**Fertilisation:** Fertilisation is porogamous. The pollen tube disappears after fertilisation.

**Endosperm:** Endosperm is of nuclear type and the seeds are endospermous.

**Embryo:** The fertilised egg divides transversely to form two cells the terminal cell *ca* and the basal cell *cb*. These two cells again divide transversely resulting a linear four celled embryo. The terminal cell of the four celled embryo is designated as *l*, the subterminal one as *l'* the next one is termed as *m* and the basalmost as *cl*. Now the two tiers *l* and *l'* which are derived from the terminal cell *ca* undergo further divisions and their derivatives contribute to the development of the embryo proper. The other two cells *m* and *cl* undergo one more transverse division forming a suspensor of four cells. Thus the embryo development conforms to the Solanad type.

#### 64. On the histology of some desert grasses.

MULAY, B. N and S. K. SALUJHA, Pilani.

1. The histology of the following desert grasses has been investigated : (a) *Cenchrus prieuri* Kunth., (b) *Cenchrus biflorus* Roxb., (c) *Cynodon dactylon* Pers., and (d) *Saccharum munja* Roxb.

2. Cambium is absent and there is no secondary growth.

3. Cuticle and sub-hypodermal sclerenchymatous tissue are well developed.

4. According to Cheadle's classification of vascular bundles, type IV occurs in grasses, but types I and II are also recorded in the grasses studied.

5. The peripheral vascular bundles have no well developed metaxylem and the protoxylem is entirely absent.

6. Midrib is not distinct and the ribs are almost similar.

7. In *C. prieuri*, *C. biflorus* and *Cynodon dactylon* the vascular bundles in leaves are of two kinds, small and big. The bigger vascular bundles occur at intervals and in between the smaller bundles. In *Saccharum munja* four kinds of vascular bundles have been recorded, the smallest kind of bundles alternating with the other kinds.

8. Chlorophyll containing bundle sheath is well developed except in *Saccharum munja*, where it is absent.

9. Bulliform cells alternate with upper epidermal strips.

#### 65. Notes on the grass *Eremopogon foveolatus* Stapf.

S. C. PANDEYA, Jabalpur.

*Eremopogon foveolatus* Stapf belongs to the subfamily Panicoideae, Tribe Andropogoneae and group -Amphilophiastrae amongst grasses.

The grass shows a very close resemblance with *Bothriochloa pertusa* Willd. a species belonging to the same group, tribe and subfamily. Similarities between

the two species have been tabulated in the text. The two grasses differ from each other on the following points :—

(i) *Eremopogon foveolatus* has only one raceme at the end of culms and branches, whereas *Bothriochloa pertusa* has 2 to 8 racemes per panicle in normal course, and also shows solitary raceme when under interspecific competition. In the last named condition the general appearance of *B. pertusa* closely tallies *E. foveolatus*. Thus the number of racemes cannot be taken as a distinguishing character of *E. foveolatus* as given by Blatter and McCann in "The Bombay grasses."

(ii) Number of nerves in lower involucral glume of both sessile and pedicellate spikelets is 3-5 in case of *E. foveolatus* and 5-8 in case of *B. pertusa*.

It is quite evident in view of the similarities that putting the two grasses in different genera is quite unnatural. This problem has been discussed in the paper. Two alternatives have been suggested for the status of *Eremopogon foveolatus* Stapf :—

(I) *E. foveolatus* may be given only the varietal rank of *Bothriochloa pertusa*.

(II) *E. foveolatus* may be renamed as *Bothriochloa foveolatus*.

In order to decide this culture experiments are in progress. The experiments aim to grow the plants of both the species under different ecological conditions of soil and plant competition.

#### 66. The Embryology of *Cassytha filiformis* Linn.

R. L. N. SASTRI, Waltair.

The only available information on the embryology of the parasitic twiner *Cassytha filiformis* is contained in some casual observations of Mirande (1905) on the structure of the ovule, fruit and seed, many of which proved to be erroneous during the course of the present study.

The anthers are two celled. The mature anther wall is five layered of which the innermost forms tapetum of periplasmodial type and the hypodermal layer becomes the fibrous endothecium. Division of pollen mother cells is successive. Mature pollen grains are two celled and monocolpate with a thin exine which shows small spinescent outgrowths.

The gynoecium consists of a single carpel with a single anatropous, pendulous, crassinucellate, bitegmic ovule. The archesporium in the ovule is multicellular and the hypodermal archesporial cells cut off primary parietal cells while the deep seated ones function directly as megaspore mother cells. About 4 layers of parietal tissue are formed. Numerous megaspore mother cells undergo meiotic divisions and give rise to linear tetrads of megaspores of which the chalazal megaspores are functional and form embryo sacs of Polygonum type. Upto about six mature embryo sacs are formed in a ovule. The embryo sacs begin to elongate in the direction of the micropyle at the two nucleate stage crushing the intervening cells of the nucellus and eventually about one to four of them succeed in protruding beyond the nucellus and enter the overarching funiculus which lies in close contact with the nucellus in the micropylar region. Meanwhile cells of the funiculus break down in the region just below the style resulting in the formation of a more or less wide canal which extends into the interior breaking its way through the vascular strand. One or two mature embryo sacs lie directly abutting on this canal and one of them is usually fertilised while all others degenerate. The organization of the mature embryo sac shows no unusual features.

Endosperm is of the cellular type and fills the entire seed replacing the nucellus when the seed is full grown. Finally in the mature seed the entire endosperm is consumed by the growing embryo. Endosperm cells contain small oil globules and no starch.

The first division of the zygote is transverse. Subsequent divisions in the two daughter cells may be transverse or longitudinal. The mature embryo has two very massive cotyledons encassing the radicle and plumule which shows the first leaf primordia, and fills the entire seed.

The mature fruit wall consists of an outer fleshy zone made up of the outer epidermis and about 7-8 layers of crushed parenchymatous cells and an inner zone of radially elongated thick walled cells comprising the inner epidermis.

The inner integument completely disappears in the mature seed while the outer integument consists of an outer epidermis of radially elongated cells, a few layers of parenchyma and an inner epidermis of radially elongated cells whose walls are peculiarly lignified and which are sometimes called the transfusion tissue.

Embryological evidence shows overwhelming similarity between *Cassytha* and other members of Lauraceae and does not lend support to the view that it should be removed into a separate family Cassythaceae.

### 67. Embryology of *Hibbertia*.

R. L. N. SASTRI, Waltair.

The chiefly Australian genus *Hibbertia* is the largest in the family. The present paper describes the structure and development of the anther, pollen, embryo sac and endosperm in *H. stricta* var. *glabriscullata* Benth. and structure and development of endosperm, embryo, fruit and seed in *H. acicularis* R. Br. the material of which has been kindly sent by Dr. C. Venkata Rao from Tasmania.

The anther wall consists of 5 layers of which the innermost forms tapetum of secretory type with a tendency towards the formation of a periplasmodium. The epidermis of the anther persists as a conspicuous layer in the mature anther and its cells show dark brown contents. The subepidermal wall layer becomes fibrous endothecium. Mature pollen grains are two celled, tricolpate and devoid of sculpturing on the exine.

The ovules are anatropous, bitegmic and crassinucellate. The micropyle is formed by both the integuments but the exostome and endostome are not in a line. Just after fertilization the cells of the outer epidermis of the inner integument become radially elongated and acquire spiral thickenings on their walls. The vascular strand of the ovule travels a little beyond the chalaza towards the outer integument. After fertilization the ovule becomes amphitropous. The single archesporial cell in the ovule cuts off a parietal cell which forms a parietal tissue of about 4 layers at the megaspore mother cell stage and upto about 8 layers at the tetrad stage. In addition to this the nucellar epidermis becomes two layered in the apical region. Embryo sac development is of the Polygonum type. Antipodals are ephemeral.

Endosperm is of nuclear type in both species. In *H. acicularis* there is an accumulation of endosperm nuclei just below the zygote besides those lining the periphery of the embryo sac, even before the first division of the zygote. Wall formation in the endosperm proceeds centripetally and by the time the embryo is globular the entire endosperm becomes cellular and replaces the nucellus but for a single lining layer.

In *H. acicularis* the "zygotic membrane" shows a tendency towards the formation of a mantle like structure similar to that described by Swamy and Periasamy (1955) in *Acrotrema* but it is not so pronounced as in the latter. The embryo has a suspensor. The mature embryo is large in size and fills nearly half of the seed.

The outer integument remains two layered in the seed and the cells of its inner layer become thick walled with branching pits while cells of the outer layer become radially elongated and are filled with tannin. The inner integument becomes four layered after fertilization and of these the cells of the inner layer

are filled with dark brown contents. During later stages the cell walls of the outer layer become spirally thickened and in nearly mature seeds only this layer persists while all others are crushed.

The fruit wall consists of an outer epidermis of large radially elongated cells with a greatly thickened cuticle and about 4 layers of parenchymatous cells internal to it. The cells of the seed coat become crushed in the mature seed.

Embryologically *Hibbertia* shows many resemblances to the genera previously studied in detail, namely, *Wormia* and *Acrotrema*.

**68. Relation of the vascular pattern to certain morphological features of the root in *Impatiens balsamina* L.**

S. K. SINHA and C. M. BASTIA, Cuttack.

The vascular pattern of the adventitious roots of *Impatiens balsamina* is much variable. The morphological features of the roots of different vascular pattern have been noted in this paper. These are height of emergence on the stem, length and thickness of the root; relative width and area of the cortex, the vascular cylinder and the pith, and number of cortical cell layers. It is found that roots with greater number of vascular strands are inserted higher up on the stem; are shorter and thicker; and show a narrower vascular cylinder; wider pith, and smaller cortex but greater number of cortical cell layers than the roots with a simpler pattern, i.e., with smaller number of strands. Thus a definite relation is found to exist between the pattern and these morphological features. The implication of this relationship is briefly discussed.

**69. Embryo development in *Antigonon leptopus* Hook et Arn.**

B. S. SIVA RAO, Waltair.

Development of embryo of *Antigonon leptopus* has been worked out in detail. The first division of the zygote is transverse. The four celled proembryo is in three tiers, the upper tier of two adjoining cells derived from *ca* and a middle tier and a lower tier of one cell each *m* and *ci* respectively derived from the original basal cell of the two-celled proembryo. The derivatives of both *ca* and *cb* contribute to the formation of the embryo. There is no epiphyseal cell formation during the development. The embryo development keys out to the Polygonum Variation of Asterad Type.

**70. The Structure and Development of the Seed and Fruit of *Mammillaria tenuis* DC.**

Y. D. TIAGI, Saugar.

The mature ovule of *Mammillaria tenuis* is crassinucellate, with a prominent somewhat conical nucellar cap (also called epidermal cap), formed as a result of repeated periclinal and anticlinal divisions in the nucellar epidermis. The cells of the nucellar epidermis situated immediately below the micropyle pericline only once in pre-fertilization stages, but become much radially elongated. The ovule is bitegmatic and both the integuments are two layered, except in their apical region, where both are several layered, the inner always thicker than the outer; the micropyle is constituted solely by the inner integument. During the development of the ovule, a prominent space is observed between the integuments and sometimes also between the inner integument and the nucellus in the chalazal region. The total curvature of the funicle is about 315 degrees and the term 'hemicirclingtropous' is coined to describe it.



The archesporium consists of two or more hypodermal cells or a group of cells, in which some cells are hypodermal and others lie inner to the latter. Sometimes, there is a single hypodermal archesporial cell. In any case, generally only one or two of them cut off primary parietal cells, the rest merging into ordinary nucellar cells and in most cases only one megaspore mother cell develops further. The primary parietal cell first divides anticleinally and there is only one pericleinal division, so that there are only two wall layers, which are subsequently pressed out of existence by the enlarging embryosac.

The megaspore mother cell undergoes the usual meiotic divisions to form a linear or a T-tetrad of four megaspores. The chalazal megaspore functions and the other three degenerate. The development of the female gametophyte conforms to the monosporic *Polygonum* type. The antipodal cells are generally ephemeral. The large and conspicuous polar nuclei lie in the vicinity of the egg and appear to fuse late in the development of the embryosac. The synergids are prominently hooked and often show a filiform apparatus. Two cases of twin embryosacs and several abnormalities in the development of the female gametophyte have been observed.

Broad and persistent pollen tubes have been observed in a number of ovules, in a few cases extending right from the tip of the micropyle into the embryosac and in one case, one male nucleus has been observed in contact with the egg and the other in contact with one of the two polar nuclei which are still free. Abundant nuclear endosperm has been observed in seeds contained only in a small percentage of the fruits, most of which contain seeds without embryo and endosperm, but with a dark bright seed-coat. Wall formation never occurs in the endosperm. Polyembryony due to the presence of adventive embryos of nucellar origin is abundantly present in ovules in which endosperm has developed. Most of the adventive embryos have a well developed suspensor. The mature seed generally contains one embryo, but this is accompanied in most cases by a second small embryo. The mature embryo is a globular structure, without any differentiation into cotyledons, plumule, radicle and hypocotyl. Some endosperm persists in the mature seed.

The seed-coat consists of three layers, outer and middle derived from the two layers of the outer integument and the inner derived from the inner layer of the inner integument, the outer layer of which is completely obliterated during the maturation of the seed-coat. The thickening of the outer tangential wall of the epidermal cells of the seed-coat is very characteristic. The fleshy fruit is of a brilliant red colour. The pericarp consists of about 12 to 15 layers of juicy parenchymatous cells with inter-cellular spaces and with a cell here and there full of a mass of mineral crystals. Stomata of 'Rubiaceous' (Paracytic) type occur in the epidermis of the pericarp.

**71. Embryological studies in the genus *Asparagus*. I. The male and female gametophytes in *A. racemosus*, Willd., *A. sprengeri*, Regl., *A. officinalis* and *A. plumosus*, Baker.**

J. VENKATESWARLU and C. S. K. RAJU, Waltair.

Organogeny, microsporogenesis and male gametophyte and megasporogenesis and female gametophyte have been studied in *Asparagus racemosus*, Willd., *A. officinalis*, L., *A. sprengeri*, Regl., and *A. plumosus*, Baker.

**Organogeny:** The various floral whorls arise in an acropetal succession in all the species.

**Microsporogenesis and male gametophyte:** The anther shows a wall consisting of three layers under the epidermis. The hypodermal wall layer develops into the



fibrous endothecium and the innermost into the secretory tapetum. The tapetal cells become two to four nucleate. Pollen mother cells divide in a successive manner. T-Shaped, Isobilateral and decussate pollen tetrads have been met with. The pollen grains are two-celled at the time of shedding and contain abundant starch. Exine is smooth and has a germinal furrow. -In *A. plumosus* the anthers degenerate totally and the degeneration usually begins at about the time when meiosis sets in the nuclei of the pollen mother cells.

*Megasporogenesis and female gametophyte*: The ovules are anatropous, bitegmic and crassinucellate. Micropyle is formed by the inner integument alone. The primary archesporium in the ovule consists of a single hypodermal cell. A parietal cell is cut off. Both T-shaped as well as linear megaspore tetrads have been met with. An embryosac diverticulum develops on the side away from the funicle due to an unequal growth of the embryosac. It functions as a haustorium and helps in the nourishment of the embryosac. Consequently the antipodals are pushed to a side and come to lie in a position at right angles to the longitudinal axis of the ovule (Chalazal-micropylar). The Synergids are hooked and show a filiform apparatus at their apices. The egg has an apical vacuole and basal nucleus situated in the lining of the cytoplasm. The antipodals of *A. plumosus* become multicellular.

## 72. Embryological studies in Iridaceae.

J. VENKATESWARLU and P. SAROJINI DEVI, Waltair.

Embryology of *Eleutherine plicata* and *Belamcanda chinensis* has been studied.

The succession of floral organs is in acropetal order. The structure of the anther in both the species shows epidermis and wall layers (three in *Eleutherine plicata* and two in *Belamcanda chinensis*). Uniseriate binucleate secretory type of anther tapetum is formed. The hypodermal wall layer becomes differentiated into fibrous endothecium. The division of pollen mother cells is of successive or simultaneous type. Hence cytokinesis is by cell plate formation or by furrowing. The mature pollen grains are two nucleate at the shedding stage.

The ovary is tricarpeal syncarpous, inferior and contains numerous anatropous bitegmic crassinucellate ovules in two rows in each locule. Micropyle is formed by the inner integument alone. Parietal cell is cut off in *Belamcanda chinensis* which forms one layer of parietal cells under the epidermis. These soon get crushed by the growing embryo sac. Some nucellar epidermal cells divide periclinally in both plants though they lie in different positions in both the plants. The nucellus is completely crushed in the seed.

The primary archesporium in the ovule is usually single celled and occasionally two or three celled. The development of the embryosac takes place according to the Polygonum type. The embryo sac shows normal structures in both. In *Eleutherine plicata* the antipodals are persistent.

Fertilisation is porogamous. An obturator is formed from the funicle in both plants.

Endosperm is of the nuclear type. It becomes cellular in *Eleutherine plicata*. The walls of the endosperm cells thicken and store hemicellulose.

Embryo development has been studied in *Eleutherine plicata*. Embryo development takes place according to Asterad type and keys out to Muscari variation.

The seed coat is mainly constituted by the two integuments. At the chalazal region there is hypostase formation. Major part of the mature seed is occupied by cellular endosperm which encloses the mature embryo.

**73. Embryological studies in the genus *Canna*.**

J. VENKATESWARLU and N. SAROJINI, Waltair.

The embryology of *Canna indica* and *Canna orientalis* have been studied. Floral whorls develop in acropetal order.

The anther wall consists of epidermis, two layers of fibrous endothecium, three middle layers and two or more seriate tapetum which is of secretory type. The sporogenous tissue is extensive and the pollen mother cells divide in a successive manner. Cytokinesis is by cell plate formation. Mature pollen grains are 3 celled. A proportion of the pollen grains are sterile in both the species.

The ovary is tricarpeal, syncarpous and inferior and contain numerous ovules on axile placentation. The ovules are anatropous, bitegmic and crassinucellate. Micropyle is formed by both the integuments. Only the upper part of the mature ovule is constituted by nucellus proper and the major part of the ovule from the base is constituted by a cup like extensive chalazal growth. The nucellus is completely consumed in the seed and the perisperm is formed by the unconsumed part of the chalazal tissue only.

The single primary archesporial cell in the ovule cuts off a parietal cell and a megaspore mother cell. The megaspore mother cell undergoes the two meiotic divisions and forms a linear tetrad of megaspores. The chalazal megaspore forms an 8-nucleate embryo sac after three successive free nuclear divisions in it.

Fertilisation is porogamous and pollen tubes in the ovules of *Canna orientalis* are rather stout and persistent.

Endosperm in *Canna orientalis* is of the nuclear type.

The embryo development is found to take place according to the Asterad type and keys to Muncari variation. Two cases of polyembryony have been met with in *Canna orientalis*. The seed coat shows in the chalazal region an outer palisade layer, inner thin walled parenchymatous tissue, vascular bundles, the thick walled double layer and finally the perispermous tissue. At the apical part it consists of the outer integument, the epidermis of which is elongated to form the palisade layer and the inner integument consisting of two layers of thin walled cells. Stomata are present on the seed coat.

An aril and micropylar collar also are seen though their origin is different from that in other Scitamineae.

(x) Cytology and Genetics

**74. Effects of Maleic Hydrazide on differentiated chromosomes.**

S. S. BHATTACHARYA and H. CHATTERJEE, Barrackpore.

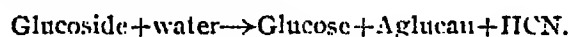
Maleic hydrazide, an anti-auxin substance possessing growth retarding properties, has been reported to show mutagenic activities. It produces breaks at low concentrations selectively at the heterochromatic regions of the chromosomes. Experiments were conducted in this Institute to study the effects of Maleic Hydrazide using plants with different euchromatic and heterochromatic patterns of their chromosomes. Root tips were treated with MH 30, a Maleic Hydrazide preparation of diethanolamine salt, with 1%, 0.1% and 0.01% concentrations for 6, 12 and 24 hours. In *Vicia faba* chromosomes, breaks could not be induced using either of the concentrations mentioned above. Previous authors had reported breaks in the heterochromatic regions of this material. In *Crotalaria juncea* extensive chromosome corrosion, disintegration of nuclei, despiralisation, extreme shortening and wide scattering of chromosomes were observed. The intensity of effects produced diminished progressively with the lower concentrations used, but the time treated

did not appear to have any influence. In *Allium cepa* at 0.1% concentration, chromosomes at mid-prophase and metaphase stages showed presence of heavy breaks. Sometimes as many as 30 or more fragments could be seen in the dividing nuclei. At higher concentrations more drastic effects were noticed, e.g. coagulation of nucleic acid, distortion and perforation of nuclei, complete non-staining and thinning out of the chromosomes. Of all the plants *Impatiens balsamina*, which contains most heterochromatin, showed pronounced damages from MH. The cells and nuclei were disintegrated, the identity of chromosomes were lost, extreme shortening of chromosomes and drainage of nucleic acid took place. Breaks were not found but reconstituted and recombined nuclei suggested that probably breaks were healed quickly due to larger heterochromatic area of the chromosomes, as found in similar X-radiated materials. It is concluded that Maleic hydrazide produces breaks in the chromosomes besides simulating other properties of radio-mimetic chemicals, but heterochromatin alone may not be selectively attacked by MH as previously contended.

#### 75. Cyanogenesis in White Clover and methods for its detection.

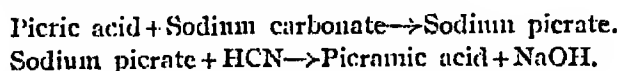
AJIT KUMAR CHAKRAVARTY, Haringhata.

Hydrolysis of a glucoside by its appropriate enzyme in the presence of water, resulting in the production of hydrocyanic acid is called cyanogenesis and is represented by the following equation.



Guignard's picrate paper test, Fiegl's spot test and prussian blue reaction are known as the standard tests for detection of HCN. Of these the Guignard's test is more reliable and followed by all who worked on cyanogenesis of white clover.

Guignard's test is made by inserting a strip of moist sodium picrate paper inside a small test tube containing the plant material, the tissues of which have been crushed by a metallic rod. The change of colour of the picrate paper from yellow to orange, red or deep brown indicates the presence of HCN in the plant material. The reaction is given by the equation.



Formation of picramic acid is indicated by the change in colour of the moist picrate paper from light brown to deep red.

Guignard's test was found to be suitable for routine testing purposes of large number of individuals. Experiments regarding stage of growth of the leaves and age of plants at which they should be tested, were carried out. It was observed that single leaf of any age was sufficient to give positive reaction for HCN in a 4 cm x 4 mm Durham tube. It was also observed that plants could be tested for HCN from the cotyledon stage to the stage of maturity. Single test was not reliable, hence repeated testing of the same individual was made for phenotypic classification of individuals.

Four phenotypes of white clover occur in nature of which one type gives positive reaction for HCN and the other three types are negative, because they lack either in glucoside or in enzyme or in both. To detect the presence of enzyme one percent solution of lotaustralin and to identify the negative plants having glucoside, one percent crude linseed meal solution was used. When one or two leaves from a negative plant possessing the enzyme were crushed in a tube containing leaves of another negative plant having the glucoside positive reactions were obtained.

**76. Cytology of Ramie : effects of fixatives on the chromosomes.**

H. CHATTERJEE and S. S. BHATTACHARYA, Barrackpore.

Chromosome studies of Ramie, *Boehmeria nivea*, proved to be difficult due to the presence of very short chromosomes and excessive cellular contents, like mucilage and starch which mask the chromosomes. Ordinary methods of fixing and staining failed to bring any clarity of the chromosomes or remove the unwanted foreign materials from the cells. Attempts were made with several prefixatives to improve the preparations and Colchicine, Aesculine, Coumarin, 8-Oxyquinoline,  $\alpha$ -Bromonaphthol and para-dichlorobenzene were used at different concentrations for different duration at different temperatures. Coumarin and Aesculine shortened the chromosomes but failed to remove the extra-chromosomal substances. Colchicine proved ineffective. 8-Oxy quinoline stretched the plasma and all the chromosomes came in one plane but the chromosomes did not take stain and differentiation did not improve. Of all the chemicals, treatments with para-dichlorobenzene solution for 2 hours at 10°–14° C and subsequent fixation with Acetic : Alcohol, 1:3 proved most effective. The materials responded best after staining with 1% Aceto-carminine without iron taken in a small glass tube and heated on water bath for 15 minutes after which the root tips were squashed with 1% cold Aceto-carminine. Premordanting with 45% Acetic Acid saturated with Ferric Acetate was a prerequisite.

The chromosome number of Ramie was found to be  $2n=28$ . The mitotic number was studied from root tips obtained from stem cuttings grown in sand filled pots. The frequency of Metaphase stages were very few and better divisions were induced when the pots were watered 1 hour before fixation of the root tips. In the resting nuclei and early prophase stages 28 minute heterochromatic bodies could be counted. 4 such bodies appeared to be attached with the nucleolus which was oval shaped and big in structure. The rest of the heterochromatic bodies mostly lay near the nuclear membrane. The mitotic chromosomes of Ramie are very small, 2 to 2.5  $\mu$  in length. However the use of paradichlorobenzene as prefixative confirmed its efficacy in the study of small chromosomes where excessive cell mucilage, starch or oil content hampers cytological observations. It is likely that at optimum concentration, temperature and duration of treatment, para-dichlorobenzene not only shortens chromosomes and stretches the plasma but it hydrolyses the cells to some extent increasing the clarity of their surface. We have since extended our observations on colchicine-treated and X-rayed Ramie chromosomes after prefixation with para-dichlorobenzene with equally good results.

**77. Cytological studies in three Lucknow Mosses.**

NARINDER CHOPRA, Lucknow.

The material for cytological studies was collected from different localities in Lucknow, in September-October, 1955-56.

*Mnium* sp.: The moss grows abundantly in Lucknow on the walls of the bungalows and ruins and is dioecious.

In aceto-carminine capsule squash, at diakinesis 6 bivalents were counted. This has been confirmed by the study of microtome preparations stained in aceto-carminine, fast green combinations. 4 autosomes are of equal size, the remaining two differ in size from these as well as among themselves; one of them the "m" chromosome is smallest while the other one the "M" chromosome is the largest. These are six chromosomes. Meiosis is normal.

In aceto-carminine leaf squash also, at metaphase (polar view) 6 chromosomes were counted. Five of the 6 chromosomes are rod-shaped, variable in size, and the sixth Y chromosome is dot-like.

*Pottia* sp. : This moss grows abundantly in the Residency in the crevices of ruins and is dioecious.

8 bivalents were counted at diakinesis in aceto-carmin capsule squash and confirmed by the study of microtome preparations stained with aceto-carmin-fast green combination. Two bivalents are bigger than the other six. Probably there is genotypic determination of sex.

The young gametophores raised in the laboratory were squashed and 8 chromosomes were counted at metaphase.

*Tortula* sp. : It grows abundantly in and around Lucknow and is dioecious.

10 bivalents were counted at diakinesis. Heteromorphic pair could not be ascertained.

In aceto-carmin leaf squash, at metaphase, 10 chromosomes could be counted. The chromosomes are variable in size, 9 being rod-like and the 10th dot-like. Among the 9 rod-shaped chromosomes 2 are bigger than the rest.

#### 78. Studies in the essential oil-yielding plants of India—III. Colchicine-induced polyploidy in *Ocimum kilimandscharicum* Guerke.

J. K. CHOUDHURY and R. B. BOSE, Calcutta.

To induce polyploidy in *Ocimum kilimandscharicum* Guerke with a view, ultimately, to increase its essential oil and camphor content, seeds and seedlings of this plant were treated with 0.01%—0.05% of colchicine solution for 6-24 hours. Treatment of seedlings with 0.01% of colchicine for 6 hours gave the best result in respect of their survival and induction of polyploidy. The treated and normal plants were successfully transplanted during July, 1954.

The induced plants were more tall and stout than the normal ones and also gave a larger outturn of leaves which resulted in a substantial increase in the yield of volatile matters. They also showed other polyploidal characters.

Tetraploid chromosome number was determined to be 76 in meiotic metaphase I against 38 in that of the normal plant. The meiosis in the treated plants was irregular. A long range of variation from  $n=10$  to  $n=76$ , presence of multivalents, ring-like appearance, abnormal segregation and unequal numbers of chromosome in anaphase I and subsequently in two poles were observed.

The treated plants are being maintained and multiplied by selfed seeds and cuttings for further observations.

#### 79. Cytological Investigation of the Genus *Ipomoea*.

ARUN KUMAR SHARMA and PRAPHULLA CHANDRA DATTA, Calcutta.

The present report deals with the caryotypic studies in 10 different species of *Ipomoea*, namely—*I. coccinea*, *I. grandiflora*, *I. learii*, *I. semperflorens*, *I. quamoclit*, *I. bononiensis*, *I. batatas*, *I. paniculata*, *I. ternata*, and *I. pulchella*. The chromosome numbers of 6 of these, were not reported before. The  $2n$  numbers observed by the present authors are 24, 28, 30, 48 and 78. These species differ with respect to their secondary constrictions as well as in minor caryotypic details. A gross similarity in the chromosome morphology is noticeable between different species. Variation in chromosome complement in the same tissues of the same individual have been found and their possible significance in relation to speciation within the genus has been suggested.

**80. Origin and behaviour of Chiasmata in Botrychium.**

A. R. GOPAL-AYENGAR, Bombay.

The haploid number of chromosomes in *Botrychium virginiana* ( $n=90$ ) has been reported for the first time. Numbers higher than 90 at 1 metaphase are due to the precocious separation of the paired bivalents.

More than 1 chiasma and as many as 5 chiasmata are found at early diplotene, but at 1 metaphase the number is reduced to a single interstitial chiasma in the majority of the bivalents.

Evidence is presented which indicates that terminalization takes place early and that the chiasmata "slip off" on reaching the ends of chromosomes. The final expression of the "slipping off" process results in univalence at 1 metaphase.

**81. Studies in the cytology of the Scilloideae -Structure and behaviour of chromosomes in Scilla sibirica.**

A. R. GOPAL-AYENGAR, Bombay.

The nuclear cycle has been followed through somatic mitosis, meiosis and post-meiotic mitoses in one species and two varieties. The chromosome complement ( $2n=12$ ) consists of 3 pairs of sub-median and 3 pairs of sub-terminal chromosomes of various sizes. The smallest (i.e. the I') pairs are the SAT-chromosomes and have peculiar secondary constrictions very close to the centromeres. No satellites are present in any chromosomes of the complement.

The resting nuclei of somatic, premeiotic and post-meiotic cells all show densely staining chromocenters in addition to chromonematic threads. The chromocenters in addition to chromonematic threads. The chromocenters are found more often at the ends than in the intercalary regions, and by special pretreatment are shown to be tightly coiled chromonemata which unravel during prophase and persist as differentially condensed segments in zygo-pachy-diplotene though much reduced at later stages. It is suggested that chromocenters and inversions act as localizing mechanisms for restricting crossing-over.

The chiasma frequency has been determined at diplotene and metaphase. It ranges between 6-13 per cell.

Two classes of bulbs are encountered: (i) "asynaptic", exhibiting a high proportion of univalents at diakinesis and 1 metaphases; and (ii) apparently "normal" showing a high degree of inversion hybridity.

Evidence of inversion at pachytene and anaphases of the I and II divisions are presented. These are of two types: (i) long inversions in which pairing and crossing-over take place; and (ii) short interrupted ones causing failure of pairing. A number of anaphase configurations have been observed suggesting the earlier occurrence of crossing-over in successive or overlapping inversions, involving compare and disparate types of chromatid relationships. The frequency of bridges varies from 1-6 per cell. Double bridges in one and the same or in different arms have also been seen. There is no correlation between bridge frequency and the number of univalents in a cell. Inversions in some cases are associated with translocations. The frequencies and types of dicentric bridges at I and II divisions are analysed and present an extraordinary series of interesting aberrations which in many instances are complex. In the apparently "normal" type actually less than 50% of the cells are normal. Of the remaining, about 39% of the cells possess one or more bridges and fragments at 1 anaphase; approximately 34% of the cells show bridges and fragments at II division. Nearly 8% of the cells possess 2 bridges in a cell. About 1.2% of the cells have 3 bridges and .1% show 4, 5 or 6 bridges respectively. Of the rest, about 15% of the cells have only fragments, unaccom-

panied by bridges. Acentric fragments are of different lengths and may be found free or attached to chromosomes. Circular fragments are not infrequently observed. The fragments arise in two ways: (1) from crossing-over in inversions, or (2) by actual breakage of chromosomes.

In a small proportion of the pollen mother cells there is ameiosis and restitution nuclei are found. Pollen development is associated with other abnormalities such as formation of micronuclei, hexads, suppression of II division and sterility. Some times the tube nucleus divides in the pollen grains. Interesting peculiarities are met with in following the mechanics of mitosis of the generative nucleus in the pollen tube.

From the cytological behaviour of the species, it is concluded that *Scilla sibirica* is a structural hybrid with a high degree of dyscentric hybridity.

## 82. Morphology and number of chromosomes in certain Liliaceae.

B. N. MULAY and MISS SINDHU KAHATE, Pilani.

1. Chromosome number and their morphology have been studied in *Chlorophytum steinbergianum* Roxb; *Chlorophytum orchidastrium* Lindl; *Aspidistra lurida* Baker; *Lilium tuberosum* and *Ruscus hypophyllum* Linn.

2. Somatic chromosome number of *Chlorophytum steinbergianum* and *C. orchidastrium* is  $n=14$ . This agrees with basic number  $n=7$ .

3. Somatic number of *Lilium tuberosum* is  $2n=20$ . This is not in accordance with the basic number reported in other species. The other basic numbers such as 5 and 10 are possible.

4. *Aspidistra lurida* shows a somatic number  $2n=32$  with the chromosome aberration such as lagging of chromosomes in the anaphase.

5. Somatic cells of *Ruscus hypophyllum* show a chromosome number which is 40. This is in confirmation with the basic number  $n=20$ .

## 83. Cytomorphological Studies in *Athyrium* Roth—I. Cytology.

P. N. MEHRA and S. C. VERMA, Amritsar.

To evaluate the phylogeny of the problematic genus *Athyrium*, detailed morphological, cytological and anatomical observations have been made. The present communication deals with the cytological aspect on 11 species of the genus namely: *A. acrostichoides* (Sw.) Diels, *A. anisopterum* Christ, *A. Atkinsonii* var. *Andersonii* Clarke, *A. boryanum* (Willd.) Tagawa, *A. fimbriatum* Bedd., *A. flabelulatum* (Clarke) Tard., *A. foliolosum* (Wall ex Clarke) Bedd., *A. oxyphyllum* Hook., *A. schimperii* Mougl., *A. setiferum* C. Chr. and *A. tenuifrons* (Wall) Bedd., collected mostly from various localities of Darjeeling ranging from an altitude of 1,000—13,000 ft. Following the usual aceto-carmin squash technique the course of meiosis has been critically followed and found to be perfectly normal. In each case 64 normal and seemingly viable spores are produced in a single sporangium. The  $n$ -chromosome number 40 is deeply seated in the genus and except *A. anisopterum* Christ, all of them are diploids, the former being a tetraploid with  $n=80$ . Furthermore within the limits of what has been called a single species *A. acrostichoides* (Sw.) Diels both diploid and tetraploid races have been found. They are being evaluated cytotaxonomically. All the species investigated are sexual.

On the basis of cytology and anatomy the generic name *Athyrium*, as proposed by Tagawa (1935) and Holttum (1954), has been confirmed for *Ctenitis boryanum* (Willd.) Copel. Distinctness of *Athyrium* from *Diplazium* is stressed. Broad comparisons with the already reported species are made and it is held that there is greater percentage of diploids in the Eastern Himalayas ( $27.3^{\circ}\text{N}$ ,  $88.18^{\circ}\text{E}$ , Darjeeling)

which represent geographically the sub-tropical rain forests, whereas in the tropical region there is not only a greater number of polyploids but also a higher grade of polyploidy as observed by Manton (cf. 1953 Manton and Sledge 1954). This preponderance of polyploids in the Himalayas at high altitudes may perhaps be explained on the basis that here the climatic conditions are more exacting than in the tropical regions and more or less are akin to the temperate ones but a further search in other tropical and sub-tropical areas seems essential to come to a final conclusion in regard to Manton's belief (cf. 1953) "Evolution must be proceeding faster in the tropics than in the temperate latitudes".

Except the three examples in the classical literature (Farmer and Digby, 1907) and to more out of 27 of the recently investigated ones (Manton, 1950, 1953; Manton and Sledge, 1954; Britton, 1953; Mahabale et al., 1953; Wagner, 1955 and Mehra et Verma, present communication) which show apogamy, all the other species are normal and sexual and thus this data is not in line with Mahabale's view (cf. 1953) "that most of the species of *Athyrium* are apogamous".

#### 84. Cytogenetical studies in the *Oleiferous Brassicas*.

S. S. RAJAN and C. KEMPANNA, New Delhi.

In an attempt to trace the inter-relationship between *toria*, brown *sarson*, yellow *sarson* and burma *sarson*, the ten chromosome forms of oil *Brassicac*, (i) cytological study of the  $F_1$  hybrids, with reference to the pairing behaviour of the chromosomes, (ii) cytological study of the  $F_2$  generation, and (iii) comparative cytological study of the allotetraploids of the hybrids obtained by colchicine treatment with the autotetraploids of the parents, were undertaken. *Toria*, as the male parent, was crossed with the three *sarsons*, and the hybrids and hybrid progenies were studied by the aforementioned methods.

Cytology of the hybrids indicated, that in all the three cases the hybrid plant showed heterozygosity for chromosome inversions. The inversions were all of the paracentric type probably situated in the short arms of chromosomes with submedian centromere. The inversion in the case of burma *sarson* was the longest. The length of the inversions in terms of genetic map units were 8.4 units in the case of brown *sarson*, 15.6 in the case of yellow *sarson* and 21 units in the case of burma *sarson*. These comparative lengths were independently confirmed by the frequency of four strand double crossovers within the inversion loop. In the  $F_2$  generation the inversion heterozygotes were recovered in an approximate ratio of 1:1, in accordance with expectations. There were indications that besides gross structural differences like inversion, small structural differences, cytologically not detectable but manifested in the preferential pairing in the allopolyploid, also existed. Sterility of the  $F_2$  individuals was also noticed as a manifestation of this cryptic structural hybridity. In the case yellow *sarson* and *toria*, sterility due to gene-cytoplasm interaction was also noticed.

It is concluded from a study of the coefficient of hybridity, that brown *sarson* is more closely related to *toria* than the other two *sarsons*. In the process of differentiation of *toria*, from other members of the *campestris* group the mechanisms of isolation must have been (i) gross structural changes in the chromosomes, (ii) cryptic structural changes, (iii) genic differences and (iv) imbalance resulting from gene-cytoplasm interactions. These results are of value more to the plant breeder in bringing out the possibilities and limitations of hybridisation within the *campestris* group by delineating the inter-relationship between the different members than to the taxonomist in effecting a reclassification of the group that constitute the *campestris* complex.



**85. Extent of seed sterility in Colchicine-induced Autotetraploids of linseed attributable to irregularities of Meiosis.**

S. S. RAJAN and A. S. DHALIWAL, New Delhi.

In order to assess the extent of seed sterility, common in autotetraploids, that is attributable to irregularities of meiosis, autotetraploids of five varieties of linseed, two of high seed fertility (4-5 seeds per boll), two of low seed fertility (0.1 to 2 seeds per boll) and one of medium fertility (2-3 seeds per boll) were compared. The data were statistically analysed by testing the significance of differences by Chi square and standard error of differences, by estimating total and partial correlations and linear regression. The aberrations of meiosis that were noticed were: (i) varied frequency of multivalent formation per p.m.c., (ii) varied frequency of chiasmata per chromosome and per p.m.c., (iii) different distribution of half chiasma per chromosome of the quadrivalent, (iv) frequency of different types of quadrivalents per p.m.c., (v) non-congression of chromosomes in metaphase I, (vi) formation of micronuclei at the second telophase and (vii) formation of polyads at the tetrad stage. Of these abnormalities none was significantly correlated with seed sterility except the abnormal congression at metaphase I. The failure of a few chromosomes to congress normally at the equatorial region was significant, negatively correlated with seed fertility ( $r = -0.7^{**}$ ). As this abnormality was also positively correlated with laggards at anaphase I and II, micronuclei at the telophase II and polyads at the tetrad stage it is inferred that the abnormal congression of chromosomes at the metaphase I has given rise to these aberrations at the later stages of meiosis. A study of the partial correlations revealed that the non-congression of chromosomes at the metaphase I was not influenced by either the frequency or nature of multivalents. The causes for this non-congression are probably mechanical due to the crowding of chromosomes on the metaphase plate of the tetraploids. This is supported by a comparison of the cell volume and the volume of the metaphase plate, as also by a comparison of the volumes of metaphase plate in normal and abnormal cases. A study of linear regression between abnormal congression and seed sterility indicated that this abnormality in its highest frequency can account for only the seed sterility of 3.6 seeds per boll leaving a sterility of 6 seeds per boll unaccounted for. It is, therefore, concluded that nearly 60% of the seed sterility in the autotetraploids of linseed are not attributable to the immediate effects of aberrations in meiosis characteristic of autotetraploids. It is probable that the causes of this unexplained seed sterility are genic in nature and would, therefore, be amenable to improvement by breeding.

**86. Preliminary studies on the effects of Ultraviolet rays on the chromosomes of *Urginea indica*, Kunth. (The Indian Squill).**

K. RANGASWAMI AYYANGAR, Annamalainagar.

Previous work in this laboratory has shown that irradiation of the tubers of *Colocasia antiquorum*, Schott. with ultra-violet rays brings about appreciable physiological reaction in the shape of larger size, higher yield and increased growth vigour in the succeeding generations. The present investigation was undertaken with a view to study the possible influence of ultraviolet rays upon the mitotic chromosomes of the common Indian Squill, *Urginea indica*, Kunth.

Some abnormalities in the mitotic division have been observed. The chromosomes after their longitudinal splitting become promiscuously distributed within the cell, presumably due to the impaired spindle mechanism.

Fragments are formed some of which being distal and acentric lag for some time like univalents in the meiosis of sterile hybrids and ultimately get dis-

organised at the close of mitosis. Consequently, the normally long chromosomes appear to have become shorter in the succeeding metaphase.

More rarely the proximal fragments with attachment constrictions give rise, by end-to-end fusion, to dicentric chromosomes which naturally become stretched to form chromatin bridges during anaphase.

In the light of the observations made here as to the nature of the chromatin bridges, evidence has been adduced that the chromosomes undergo longitudinal splitting during the metaphase condition of the nucleus after the influence of ultra-violet irradiation and not in the previous telophase prior to mitosis.

The significance of fragmentation and fusion of chromosomes as contributing to chromosomal evolution in plants has been indicated. Normally chromosome evolution has proceeded on the lines of duplication of the entire complement (euploidy) or part of it (aneuploidy) with subsequent attainment of secondary balance. But the present work suggests that chromosomal fragmentation and fusion may also help to bring about alterations of a more or less permanent character in the hereditary make up of plants.

#### 87. Genetic Improvement of Bamboos through Polyploid-Breeding.

H. S. RAO, Dehra Dun.

A preliminary observation in 1953 with 3 colchicine-treated seedlings of bamboo (*Dendrocalamus strictus*) suggested an extended trial the following year when 37 plants and 7 controls were prepared for field trial. In 1956 these two-year-old plants revealed interesting characters associated with polyploidizing, namely, increased vigour, production of thicker or wider leaves, and larger but fewer tuberculate hairs on the dorsal leaf-surface. The frequency tables compiled from data on vigour, leaf thickness and number of hairs show that in about a dozen out of the 37 polyploidized plants there is a definite increase in vigour, leaf-thickness and leaf width associated with increased size of hairs, the last effect resulting in fewer number of hairs per unit area. These easily observed criteria for early evaluation of artificial polyploid mutants are of great interest and value to breeders of forest species.

#### 88. Aneuploid Cells in the Colchicine induced Amphidiploids.

R. P. ROY, Patna.

Aneuploid cells were found in several intergeneric amphidiploids derived from the genera *Triticum* and *Aegilops*. The anthers of these amphidiploids showed a mixture of cells containing both the full amphidiploid set of chromosomes and various reduced amphidiploid chromosome number. The parent species and the  $F_1$  hybrids from which these amphidiploids were derived by colchicine treatment did not show any aneuploid cells in their anthers. Again the aneuploid cells were also found in some amphidiploid  $F_1$  hybrids, but using the regular species as the female parent, no aneuploid cells were found. These aneuploid cells were found in all the three generations of the 14 amphidiploids studied, but their frequency became less in the subsequent generations. In one amphidiploid, *A. blundellii*  $\times$  *T. dicoccoides*, there was a very high percentage of aneuploid cells in the first generation and consequently the plant could set only one seed. By the third generation the number of aneuploid cells was very low and the fertility of the plants also went up to 93%. By suitable experiments it was found that the amphidiploid produced by high concentration and long duration colchicine treatment, had aneuploid cells in their anthers, but the others produced by short duration and low concen-

tration colchicine treatments were found to have no aneuploid cells. The aneuploid cells in no way interfered with the chromosome pairing in the normal cells of the same anthers, rather these cells were themselves capable of undergoing meiosis. But the aneuploid cells always had large number of univalents and they thus appear to represent at meiosis an almost random assortment of chromosomes. Aneuploid cells with considerable reduction from the full chromosome complements were able to function as gametes. Thus from the same amphidiploid plants with varying chromosome numbers can be derived.

The occurrence of aneuploid cells at meiosis is presumably due to spindle abnormalities during premeiotic mitosis. Such spindle abnormalities are usual features in the colchicine treated materials. It is suggested that these spindle abnormalities have been brought about by the transmissible toxic effect of colchicine. This would explain the presence of aneuploid cells in plants which originated from long duration treatments and their absence from those produced by short duration treatments. Their absence in the parents and the untreated  $F_1$  hybrids are also explainable on this basis.

It is further suggested that colchicine brings about the formation of abnormal spindles either by reacting with the lipid contents of the cell and centromere or by upsetting the nucleic acid cycle by affecting the heterochromatic centromere or both. The sharp fall of aneuploid cells in the successive generations of the same amphidiploids looks like a case of dauermodification. But in the hybrid in which a normal species *T. aestivum* was used as the female parent and an amphidiploid as the male parent, the hybrid did not show any aneuploid cells. Thus this does not appear to be a case of dauermodification.

It is also suggested that no permanent change in centromere has occurred. As the abnormalities tend to disappear after a few generations, the effect on the centromere was most likely narcotic and therefore reversible.

### 89. Male sterility in Palms.

SANTOSH KUMAR SARKAR, Calcutta.

The present paper deals with the male sterility in twenty-eight species of Palms. Percentage of deformed pollens and percentage of empty pollens were counted. Pollen grains were dusted on a standard medium for germination and percentage of ungerminated grains were calculated.

Experiments involving germination of pollen grains on the stigma were conducted and percentage of ungerminated grains were noted.

The percentage of irregularities in meiosis like nondisjunction, lagging, pentads etc. has been correlated with male sterility and the different issues have been discussed.

Percentage of pollen sterility in different seasons was taken and tabulated for showing the effect of seasonal variation with pollen sterility.

Percentage of nonviable pollens were counted in different days after anthesis of flowers and the result was tabulated.

Empty anther sacs and the anthers with a few mother cells or deformed mother cells were found in some cases. After observation of a large number of inflorescences, the tip portion of the inflorescence was found to contain flowers with more sterile pollens than the lower portion of the inflorescence.

On the basis of the available data, it has been suggested that sexual reproduction is not of absolute necessity for propagation and fruit production in Palms. Propagation through vegetative means before the plant reaches maturity is of more significance than sexual reproduction in this family of plants. Fruit production, emphasized in another paper too, may depend to a large extent on apomixis.

## 90. Sex chromosomes in Palms.

SANTOSH KUMAR SARKAR, Calcutta.

The present paper embodies the results of a part of the research project undertaken on determination of sex in Palms. In the three species of Palms, viz., *Borassus flabellifer*, *Phoenix sylvestris* and *P. rupicola* one heteromorphic pair of chromosomes was distinctly observed in male plants.

Detailed karyotypes of all these three species were studied both in case of male and female plants and the behaviour of the two sex chromosomes was followed.

Meiosis could be worked out in all the cases and the behaviour of the heteromorphic pair was studied. The heteromorphic pair of chromosomes was found clearly in both diakinesis and first anaphase. No chiasma could be observed in them and they were found to lie very close to each other as associating univalents.

In all the three species investigated here, where sex chromosomes could be distinctly determined they are of XY ( $\delta$ ) and XX ( $\phi$ ) types.

The terms A & A<sub>1</sub> have been used here for X & Y to keep uniformity of description with the previous paper.

The presence of only one pair of sex chromosomes in these allopolyploid species has been explained in the basis of the origin of unisexuality after the attainment of polyploidy.

## 91. Utilisation of Cytoplasmic Male Sterility in Production of Hybrid Onion Seeds.

B SEN and S. N. SRIVASTAVA, Almora.

Work with cytoplasmic male sterile lines of onion evolved by H. A. Jones for production of hybrid onion seeds has been in progress at the Vivekananda Laboratory since 1948. For production of hybrid onion seeds different pollen parents have been used. It has been found that (i) the combining abilities of the different pollen parents are different and that (ii) the combining abilities of the fertile inbred lines—Almora Local and Shahjahanpur Local with some of the male sterile lines are at par with that of the special pollen parent obtained from Jones.

The results of different yield trials undertaken both at Almora and at Hawalbagh since 1949 indicate that the yield of onion can be doubled by the use of hybrid seeds. Further breeding work in this connection is in progress.

## 92. Chromosome Studies in Citrus I.

\* ARUN KUMAR SHARMA and ARYA KUMAR BAL, Calcutta.

A detailed investigation has been carried out on the chromosome complement of the different varieties of the four different species of *Citrus*. The normal chromosome number has been found to be  $2n = 18$  in the 'China', 'Columbia' and 'Gora' varieties of *Citrus acida aurantifolia* Pers; 'White fleshed', 'Red fleshed' and 'Chinese' varieties of *C. decumana* Murr; 'Blachi' and 'Sarbat' varieties of *C. limetta* Risso and *C. microcarpa* Bunge. In the 'Monster Kalsia' variety of *C. decumana* however, the normal chromosome complement showed  $2n = 21$  in the somatic cells. Karyotypic details were studied and it was found that the Karyotype varied in different varieties, as well as within the same tissue of a plant. Apart from this, variation from the normal number, ranging from 9 to 36, somatic reduction and unequal separation were observed in different varieties. The modes of origin of the karyotypic alterations, both numerical and structural,

have been suggested, taking place through the above abnormalities, occurring spontaneously in the cells. Their significance too, has been considered to be a main factor in evolution of species specially in view of the vegetative method, practised for the propagation of these species.

**93. Structure and behaviour of Chromosomes in different varieties of *Psidium* Guyana Linn. I.**

ARUN KUMAR SHARMA and (Miss) ARATI MAJUMDAR, Calcutta.

The behaviour of chromosomes in somatic cells of four different varieties of *Psidium* has been carried out. The varieties are Allahabad, Banaras, seedless-Bengal and Kafri. The chromosome number recorded in the Allahabad var. is 18, whereas in Benaas it is 20 and 32 is the diploid number recorded in seedless (Bengal) variety. The number of satellited chromosome is six in Allahabad and four satellited chromosomes are present in both Banaras and seedless ones. Though a gross similarity in chromosome structure of different varieties of *Psidium* is present, the presence of numerical and structural differences are not at all uncommon. Cytologically karyotypic differences between their different varieties can be considered as their identifying characteristics. The variation in the chromosome complement in the somatic tissue of each variety is also reported in quite a high frequency. The significance of somatic alteration in the origin of new varieties through vegetative means has been discussed.

**94. Effect of Nucleic Acids on Root Cells.**

ARUN KUMAR SHARMA and (Mrs.) ARCHANA SHARMA, Calcutta.

Investigations were carried out to find out the differential capacity, 'if any, between the Ribose and Desoxyribose nucleic acid treatment in inducing division in adult nuclei of root cells. These were carried out on *Allium cepa*. The two acids were applied in two different ways:—(1) Direct acid treatment, (2) Treatment in a mixture of acid and standard Knop's medium. With direct acid treatment again, observations were carried out (i) directly from the solution at regular intervals, as well as (ii) after recovery for a certain period in Knop's medium after treatment for a specific period directly in the solution. Reductional separation of chromosomes, fragmentation as well as some physical effects has been found to appear after both the acid treatments. With ribose nucleic acid, the induction of division in adult cells is more rapid than with the other. Further after a very short period of treatment in acids followed by a recovery the adult cells show division much earlier after RNA treatment than with D.N.A. The polyploid nature of adult cells has been revealed from their chromosome counts. The significance of these data has been discussed in relation to nucleic acid deficiency in normal adult cells.

**95. Cytology of different species of *Asparagus* and *Lilium*.**

ARUN KUMAR SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

The cytological investigation of the following six different species of Liliaceae has been carried out. 1. *Asparagus racemosus* Willd., 2. *A. plumosus* Baker, 3. *A. nanus* (a horticultural variety), 4. *A. sprengeri* Regel., 5. *Lilium longifolium* Griff., 6. *L. Chinese sacred lily* (a horticultural variety).

Different pretreatment methods have been applied for a detailed study of their karyotypes. The normal somatic chromosome number found in *Asparagus racemosus*, *A. plumosus* and *A. nanus* is 20 in each case, in *A. sprengeri* is 60, in *Lilium longifolium* is 24 and in *L. Chinese sacred lily* is 48. The number of secondary constrictions noted in *Asparagus racemosus* is 6, in *A. plumosus* 2, in *A. nanus* 4, in *A. sprengeri* 10, and in *Lilium longifolium* 4. Variation in the chromosome complements in somatic nuclei of the same individual have been reported. Such variations have been found to occur more frequently in species of *Lilium* as compared to the other genus. Variation has been recorded in all the six species investigated. The role of polyploidy associated with somatic alteration and structural changes of chromosomes in the evolution of the species has been discussed. In view of sexual means being either obsolete or a much less efficient mechanism of reproduction than the vegetative means in this family, such variations have been considered as possibly providing a means for the origin of new forms. This may be achieved by their entrance into the growing region and thus giving rise to new shoots with different genotypic constitutions.

#### 96. Cytology of *Asphodelus Tenuifolius* Cav.

ARUN KUMAR SHARMA and NRIPENDRA KUMAR BHATTACHARYYA,  
Calcutta.

1. A cytological investigation on *Asphodelus tenuifolius* Cav. has been carried out in detail including both the mitotic and the meiotic studies.

2. Somatic chromosome number of the species has been determined to be  $2n = 30$  and these are karyotypically divisible into eight different types.

3. Considerable amount of irregularities have been observed in meiosis. Beside the normal fifteen bivalents, most of the P.M.C.s contain two quadrivalents and eleven bivalents.

4. Secondary association between different bivalents has been noted in a number of P.M.C.s and the maximum association is  $1(4) + 3(2) + 3(1)$ , suggesting the basic number as seven. The two multivalents always lie free. The amphidiploid constitution of the species under investigation has been suggested.

5. The presence of eleven bivalents and two quadrivalents in *A. tenuifolius* has been accounted for on the basis of their origin through two different ancestors, and duplication of chromosomes in evolution. The role of allopolyploidy in the evolution of the different species of *Asphodelus* has been emphasized in view of the data gathered so far in this aspect in this species.

#### 97. Cytology of *Sorghum* L.

ARUN KUMAR SHARMA and DIPTI BHATTACHARJEE, Calcutta.

Detailed cytological studies of twenty-three species of *Sorghum* were done. Somatic studies revealed that the number most commonly found is twenty, while ten and forty have been recorded in *S. versicolor* and *S. halepense* respectively. The basic number, as worked out from secondary association counts in several species, is four. The group is remarkably homogeneous, as far as the structure of chromosomes is concerned, there being several distinct types present in each of them. Evolutionary tendencies within the genus have been traced on the basis of their chromosomal characteristics. Structural alterations have been recorded and their origin discussed. As regards speciation within the group, structural alterations of chromosomes have evidently played a large role.

**98. A study on the effect of chemicals on chromosomes of roots, pollen mother cells and pollen grains.**

ARUN KUMAR SHARMA and SANTOSH KUMAR SARKAR, Calcutta.

The present paper deals with a comparative study of chemical effect on chromosomes of root-tips, pollen grains and P.M.C.'s of *Nothoscordum fragrans* Kunth.

Three chemicals, viz., Aesculine, Paradichlorobenzene and Resorcinol were applied individually. Considerable erosion and fragments of chromosomes occurring at random were noted both in metaphase and anaphase of root-tip chromosomes. On the other hand pollen grains where also the division is mitotic, no fragmentation of chromosomes was recorded even after prolonged treatment. Diplochromosome formation after prolonged treatment was detected in pollen grain chromosomes. In case of meiotic chromosomes also fragmentation was not observed, but irregularities in division, such as lagging, nondisjunction and stickiness were detected in a number of cases.

This differential response to chemical treatment of root-tip, pollen grain and pollen mother cell chromosomes has been considered as a definite indication of differential metabolic set up of chromosomes, not necessarily involving their ultimate structure.

**99. Cytology of different species of Palms and its bearing on the solution of the problems of Phylogeny and Speciation.**

ARUN KUMAR SHARMA and SANTOSH KUMAR SARKAR, Calcutta.

Detailed karyotypes of 50 species of Palms have been studied. Most of the chromosomes of the complement are of medium to short in size with median to submedian constrictions. A gradual gradation in size of the chromosomes with the low number of secondary constrictions is a marked feature in most of the complements.

Meiotic studies have been carried out in 28 species. Meioses so far studied show bivalent formation in all of them. Secondary association of bivalents has been recorded in a few species. Irregularities like inversion bridge, lagging, nondisjunction, unequal separation and formation of pentads, hexads, etc. instead of tetrads have been recorded and their significance has been discussed. Heteromorphic pair of chromosomes, their behaviour in meiotic division and their significance have been studied.

Evidences of high percentage of pollen sterility have been recorded and the relative role of aponixis and sexual reproduction in the production of fruits have been estimated. Fruits have been found to develop in some cases from unpolinated flowers, suggesting thereby that sexual reproduction is not of absolute necessity for fruit production.

The significance of widespread variations in chromosome complement in the somatic tissue, present in the majority of the species has been discussed and suggested that their entrance into the growing tip of the daughter shoots during vegetative reproduction effects speciation in present day palms.

The behaviour of chromosomes after induced division in the adult cells has been studied. The significance of a particular abnormal number noted in the differentiated organ has been discussed.

The role of allopolyploidy in the evolution of different tribes and genera at the initial stage has been discussed. The importance of the structural changes of chromosomes including diminution in chromatin matter specially from wild to cultivated forms in evolution have been pointed out. Different cytological lines of evolution in the family have been worked out and an alteration in the systematic position of certain genera has been suggested.



### 100. Cytology of two species of Onagraceae with special reference to the structural hybridity of *Clarkia*.

ARUN KUMAR SHARMA and SANTOSH KUMAR SARKAR, Calcutta

Detailed karyotypes of two horticultural varieties of *Clarkia elegans* and *Jussieuia repens* were studied. Normal somatic chromosome numbers were recorded as eighteen and sixteen respectively in the two genera. Variations in chromosome complement in different cells of the somatic tissue were noted in *Jussieuia repens*. The role of such somatic alterations in speciation through vegetative means has been pointed out.

Cytological analysis of the two horticultural varieties of *C. elegans*, viz., rosy flowered tall variety and reddish flowered bushy variety revealed their structural hybrid nature. The apparent karyotypic similarities between the two varieties were not considered as absolute genomic similarity, as meiotic behaviour being different in the two, suggested their genotypic difference.

In rosy flowered tall variety the presence of a ring of six and a chain of four chromosomes were recorded. In reddish flowered bushy variety, on the other hand, a single chain of ten chromosomes was observed in a number of mother cells. Here in no case a ring of six and a chain of four chromosomes could be noted. The difference in size of the chromosomes in the chain was also significant suggesting nonhomologous segmental interchanges between its members.

On the basis of the meiotic behaviours of the two varieties it has been assumed that segmental interchanges between one member of the chain of four in one variety possibly have given rise to a single chain of ten chromosomes of the other variety and thus indicating the origin of one variety from the other.

It has been claimed that the varieties of *Clarkia* are good examples of structural hybrids where segmental interchanges have played a distinct role in the origin of different horticultural varieties.

### 101. Cytological Studies in *Begonia*. I.

ARUN KUMAR SHARMA and UPENDRA CHANDRA BHATTACHARYYA,  
Calcutta

The present report deals with the mitotic and meiotic studies of 4 different species of *Begonia*, including *B. laciniata*, the commonly occurring one in the plains.  $2n = 26$  chromosomes have been found in 3 of them and  $2n = 42$  in one. Karyotype studies reveal gross similarities in chromosome morphology of different species, but with minor differences in chromosome details. Evidences of allopolyploidy have been found during the meiotic behaviour of the species. Considerable amount of alterations of chromosome complements in the somatic tissues of each individual have been noted. Taking in view of the previous and the present records it has been suggested that allopolyploidy has been responsible for the evolution of different species of *Begonia* at the initial stage. Later, however, consequently with loss in capacity for sexual reproduction alterations in the somatic chromosomes of the tissue have played a distinct role in their further evolutions.

### 102. Cytological Studies in the Genus *Trachelomonas* Ehrbg.

K. P. SINGH, Nai ni Tal

*Trachelomonas grandis* Singh was studied cytologically and the chromosomal cycle was followed in considerable detail. The organisms used were grown in unialgal cultures according to the methods of Pringsheim and were fixed in



1:3 Acetic-alcohol at intervals of  $\frac{1}{2}$  hour during the night. All stages in nuclear division were obtained around midnight from week-old cultures.

The writer's aceto-carmine preparations showed the longitudinal division of the chromosomes. The chromosome reduplication is probably anaphasic and this persists in the telophases. During nuclear division, the endosome (nucleolus) elongates in a direction at right angles to the long axis of the cell, divides into two, and one portion goes to each daughter nucleus.

#### 103. Cytological Studies in *Iberis amara* L.

S. L. TANDON and P. N. BALI, Delhi.

Meiosis in pollen mother cells was studied in 30 plants of *Iberis amara* L. Out of acetocarmine, aceto-orcin, propionocarmine and crystal-violet which were used in staining chromosomes, propionocarmine gave best results. Although a few pollen mother cells at diakinesis showed an association of six bivalents and two univalents, majority of them showed seven bivalents. Seven chromosomes were clearly seen in metaphase plates. The distribution of chromosomes at anaphase I was found to be regular, seven chromosomes being clearly visible at either pole. The haploid chromosome numbers reported for the species are seven and eight. All the plants examined by us, however, fell into the category of the type with  $n = 7$ . The possibility that the haploid chromosome number in *Iberis amara* L. may be seven only and not seven and eight has been discussed.

#### 104. Cytological Studies in the Genus *Asparagus*.

J. VENKATESWARLU, and C. S. K. Raju, Waltair.

Tetraploid chromosome numbers are reported for two species of *Asparagus*, namely, *A. racemosus* and *A. officinalis* ( $n = 20$ ).

Detailed cytological studies into both the species have been made and it has been concluded that both of them are tetraploids.

Quantitative data on the multivalent frequency, types of multivalents and chiasma frequency have been acquired in the case of *A. racemosus*. The average quadrivalent frequency comes to 3.8 per cent and that of trivalent frequency to 0.3 per cent. The number of quadrivalents varies from six down to one per cell. Trivalent types 7 and 8 and quadrivalent types 11, 13, 15, 16 and 17 have only been encountered. These require the formation of a single exchange in the association, which is more possible in chromosomes with median or submedian centromeres and the pachytene complement in this plant should show at least a majority of the chromosomes with median or submedian centromeres.

In *A. officinalis* the quadrivalent frequency is very low, there being a single quadrivalent in half the number of nuclei analysed while the rest showed bivalent and univalents.

The following types of meiotic irregularities are described: (1) Univalent formation either due to failure of pairing and chiasma formation during prophase or due to the linear and indifferent co-orientation and disjunction of the chain type multivalents (false univalents) (2) formation of lagging chromosomes and the organisation of micronuclei and micro cells from these; (3) Numerical unbalance of the component chromosomes at anaphase I and (4) formation of bridges at anaphase due to the persistence of an interstitial chiasma.

Based on the observations of general behaviour at meiosis and the high quadrivalent formation it is concluded that *A. racemosus* is an auto-tetraploid.

*Asparagus officinalis* due to the low multivalent frequency, high univalent frequency and lack of proper pairing is concluded to be a segmental allopolyploid.

The various factors involved in the evolution and differentiation of species within the genus *Asparagus* have been discussed and it is concluded on the basis of the present investigation that autopolyploidy, interspecific hybridisation followed by segmental allopolyploidy and polysomy have all played a part.

#### (xi) Physiology and Phytochemistry

##### 105. Further studies on the influence of time of sowing on the effect of 2, 4-D on growth and yield of wheat.

S. N. BHARDWAJ and I. M. RAO, Agra.

The effect of pre-sowing soaking of wheat (C. 591) seeds for 24 hours in water and in 10 ppm. of two preparations of 2, 4-D, 2, 4: dichlorophenoxyacetic acid (B.D.H.) and Dicotox, Ethyl 2, 4: dichlorophenoxyacetate (M & B), when sown at 15 days intervals beginning with 3rd of November, 1955 (normal sowing time), on growth and yield of grain was investigated in pot culture. Quantitative observations on ear-emergence, height of plants at maturity, shoot-dry-weight, yield and quality of grain were recorded, and the results were analysed statistically.

Relative to control, ear-emergence was enhanced by 2, 4-D and Dicotox in the fourth sowing alone, while 'water-soaking' accelerated the same in all the sowings, but the maximum earliness amounted to less than three days. Final heights of plants were not significantly different due to treatment in any of the sowings, compared to the respective control.

Shoot-dry-matter and the yield of grain were increased by 2, 4-D in the later sowings, while Dicotox had no effect. The yield of grain with 2, 4-D in the four sowings amounted to 83%, 156%, 125% and 181%, of the respective controls (untreated seeds); the increase over the controls in the second and fourth sowing were significant. Grain-to-shoot ratio was lower with 2, 4-D, especially in the later sowings, while with Dicotox it was so in the third sowing alone. 'Water-soaking' seems to have produced no beneficial effect except increasing the dry matter in the plants of the last sowing.

The present studies indicate that 2, 4: dichlorophenoxyacetic acid seems to be definitely more beneficial than its ethyl ester (2, 4: dichlorophenoxyacetate), and the beneficial effect on the yield can be obtained only in the delayed sowings. The results support the earlier findings of the authors (1955 and 1956).

Further, it may be added that 2, 4-D treatment can improve the yield almost to the level of the normal sowing, even if the sowing is delayed upto the first week of December. The yields obtained in the present investigation in this connection are: normal sowing-control: 1.56; sowing in the first week of December-Control: 1.13 (significantly lower than the above 'Control'); 2, 4-D treated: 1.41 grams (not significant) per plant.

##### 106. Thioctic acid and photosynthetic CO<sub>2</sub> fixation.

B. B. BISWAS and S. P. SEN, Calcutta.

Calvin and coworkers have advanced some experimental evidence that 6, 8-thioctic acid the prosthetic group of pyruvic oxidase, influences the Hill Reaction in which photosynthesis is concerned with the evolution of oxygen. An investigation was undertaken to study whether the photosynthetic reduction of CO<sub>2</sub> is stimulated by thioctic acid.

Suspensions of *Chlorella pyrenoidosa* and *Scenedesmus obliquus* were used. 7 days old cultures were centrifuged at 12°C and suspended in phosphate buffer of pH 6.8. These were then incubated with 0, 10, 25, 100, 250, 1,000 µg/ml of thioctic

acid and 30  $\mu$ C of  $\text{NaH}^{14}\text{O}_3$ , in high intensity light at 26°C. for 30 min. The reaction was stopped with boiling ethanol and evaporated to dryness. The residue was either resuspended in 80% ethanol and aliquots counted, or, counts were taken in saturation thickness after being mixed with non-radioactive algal cells when necessary. No sharp stimulation of  $\text{CO}_2$  uptake was observed. Addition of quinone (which is known to act as a hydrogen acceptor) in the *Scenedesmus* cells had no marked effect. Low concentrations of thiocetic acid slightly promoted the rate of photosynthetic uptake of  $\text{CO}_2$ .

When the 80% ethanol extract was subjected to two dimensional paper chromatography with phenol-water and butanol-acetic acid-water as the developing solvents the autoradiograms revealed that bulk of the label was incorporated in the phosphate esters, sucrose, malic and fumaric acids.

#### 107. Uses of isotopes in the nucleic acid metabolism of Cyanophyceae.

B. B. BISWAS, Calcutta.

While separating DNA and RNA of *Nostoc muscorum* from sodium nucleate with 0.3N KOH solution was observed that a portion remained insoluble. This insoluble fraction, henceforth designated as  $\text{DNA}_1$ , after analysis revealed the same constituent bases as those of  $\text{DNA}_2$  but in different ratios. This  $\text{DNA}_1$  fraction was completely absent in *Chlorella*.

The nucleate isolated with 10% NaCl from *N. muscorum* constituted 9-10% of the dry weight. DNA content was between 2.5-3% and RNA 6-7% of the dry weight,  $\text{DNA}_1$  being 1.3-1.6% and  $\text{DNA}_2$  1.2-1.4%. The molar ratio of different bases in  $\text{DNA}_1$  and RNA was found to be as follows and both the nucleic acids were of 'CG' type.

			$\text{DNA}_1$	RNA
Guanine	...	...	1.5	1.2
Adenine	...	...	0.75	1.0
Cytosine	...	...	1.0	1.0
Thymine	...	...	0.75	Uracil 0.8

In  $\text{DNA}_1$  all the bases were found to be present in almost equal proportion. RNA revealed the presence of three sugars (i) Arabinose (ii) Ribose and probably (iii) Glucose;  $\text{DNA}_1$  a single sugar corresponding to Deoxyribose; and  $\text{DNA}_2$  (i) Galactose, (ii) Glucose (iii) Arabinose and (iv) Ribose.

It was found that  $\text{P}^{32}$  uptake into RNA and  $\text{DNA}_1$  increased with time upto a certain period. In  $\text{DNA}_1$  there was a fall in the  $\text{P}^{32}$  content after 4 hours, and reached low values in 24 hours. The rate of incorporation of  $\text{P}^{32}$  in both  $\text{DNA}_1$  and RNA was high during the 1st hour. In  $\text{DNA}_2$   $\text{P}^{32}$  uptake increased with time upto 24 hours. The decrease in activity in  $\text{DNA}_1$  after 4 and 8 hours was associated with a corresponding increase in the  $\text{DNA}_2$  fraction, which suggested a rapid turnover of the former to the latter.

The rapid turnover of DNA ( $\text{DNA}_1$  +  $\text{DNA}_2$ ) was probably due to high rate of cell division. In the individual nucleotides of  $\text{DNA}_1$  the incorporation of  $\text{P}^{32}$  seemed to be a function of the time. In Uridylic acid there was a decrease in activity after 8 hours.

The total incorporation of  $\text{C}^{14}$ , when  $\text{NaH}^{14}\text{O}_3$  was used as a source, in  $\text{DNA}_1$  and  $\text{DNA}_2$  increased upto 4 hours and 2 hours respectively and then there was a decline in the activity. The nature of the curve, so far as the total incorporation was concerned, was similar in both the cases, But in RNA there was a steady increase in activity throughout the experimental period. Very little activity in guanine was detected as compared to other bases.

When  $\text{HC}^{14}\text{OOH}$  was used as a source, a great deal of activity was detected in  $\text{DNA}_1$ . There was a steady increase in activity in  $\text{DNA}_1$  and  $\text{DNA}_2$  as time increased but in the case of RNA the total incorporation increased upto 4 hours after which the activity remained more or less same upto 6 hours. Purine and pyrimidine bases were equally tagged even after  $\frac{1}{2}$  hour of incubation. Further work is now in progress.

#### 108. Observations on flowering, anthesis and blooming in some Forage Legumes.

AJIT KUMAR CHAKRAVARTY and ARUN PRAKASH CHAUDHURI, Haringhata.

Studies were made on (i) flowering time, (ii) blooming time and its duration (iii) time of anthesis and its relation with blooming in (a) *Pisum sativum*, (b) *Cicer arietinum*, (c) *Lathyrus sativus*, (d) *Phaseolus calcaratus*, (e) *Phaseolus aureus*, (f) *Phaseolus ricciardianus* and (g) *Phaseolus trilobus*. The mean time of flowering in the Rabi legumes viz. *P. sativum*, *C. arietinum* and *L. sativus* was observed on the 29th December, 5th January and 1st January, their mean flowering periods being 57, 67 and 69 days respectively. The maximum, minimum temperatures, relative humidity and day-length at the time of flowering of the different varieties of the above species varied within a narrow range, the mean figures being  $80^\circ\text{F}$ ,  $50^\circ\text{F}$ , 60 and 10 hours respectively. The mean dates of flowering in the Kharif legumes viz., *Phaseolus calcaratus*, *P. aureus*, *P. ricciardianus* and *P. trilobus* were 17th December, 19th October, 16th October and 8th August respectively. The last three *Phaseolus* species flowered at a time when the maximum temperature was  $90^\circ\text{F}$ , the minimum  $70^\circ\text{F}$ , the relative humidity 80 and the day-length was 12 hours. *P. calcaratus* behaved as a short day plant and at the time of its flowering, the maximum, minimum temperatures, the relative humidity and the day-length were  $83^\circ\text{F}$ ,  $49^\circ\text{F}$ , 60 and 10 hours respectively. Anthesis was always found to occur in the flower buds of the different species before they were fully bloomed and accessible to the pollinating insects. The interval of time between anthesis and blooming of the flower buds ranged from 2 to 4 hours. The blooming time of flowers as well as their blooming duration recorded in different species varied from day to day. This variation is comparatively larger than the variation observed in daily atmospheric temperatures and relative humidity. The variation of length and breadth of the standard of the flowers was not so large in comparison to the variation of their blooming duration. The optimum time for the starting of blooming in *Phaseolus calcaratus* which was observed in January was 9 a.m.; but the optimum time for the same in the other three Kharif legumes which were observed in November was 6 a.m. The early start of blooming in the latter species may be due to comparatively early rising of the sun and higher early morning temperatures in November.

#### 109. Effects of $\alpha$ -naphthalene acetic acid on seeds of *Linum usitatissimum* Linn. at different stages of vernalization.

S. C. CHAKRAVARTY, Bhopal.

It has been previously recorded that it is possible to inhibit the process of vernalization in *Linum* by soaking seeds with solutions of certain plant growth substances before chilling. Present investigation aims to determine the effects of a similar treatment with 50 ppm of NAA during the progress of vernalization.

It is observed that as a result of the above treatment, further vernalization in incompletely vernalized seeds is arrested but the changes that have already taken place are not nullified. This indicates that the process of vernalization in *Linum* is a continuous one and unlike winter cereals does not proceed

**110. Studies in the physiology of fruits and vegetables. I—Physiological changes in Litchi (*Litchi chinensis* Sennar) during storage.**

J. K. CHOWDHURY and HARIDAS BANERJEE, Calcutta.

Mature litchies were gathered from the market supply in Calcutta in 1955 and were stored in normal ( $89^{\circ}$ - $93^{\circ}$ F) and low temperature ( $36^{\circ}$ - $38^{\circ}$ F) in order to study their keeping quality and other physiological changes.

While the fruits could be preserved in edible condition for 32 days in  $36^{\circ}$ - $38^{\circ}$ F they did not keep in  $89^{\circ}$ - $93^{\circ}$ F even for a week. The fruits, however, turned brown in both the temperatures within 48 hours.

During storage in  $36^{\circ}$ - $38^{\circ}$ F total acid, Vitamin C and water content of the fruits decreased, but the total sugar, alcohol soluble matter and the total dry weight registered an increase. Reducing sugar was always available in the fruits in larger quantity than sucrose which appeared later during the storage period.

**111. Studies in the physiology of fruits and vegetables. II—Analytical observations in Darjeeling oranges.**

J. K. CHOUHDURY and HARIDAS BANERJEE, Calcutta.

Mature, green oranges, variety Darjeeling, were brought down to Calcutta from Darjeeling in November, 1955 to observe the physical and chemical changes that take place in the fruits during storage. Some of these fruits were kept in normal temperature ( $78^{\circ}$ - $83^{\circ}$ F) where they lasted in a marketable condition for two weeks. Others were kept in low temperature of  $36^{\circ}$ - $38^{\circ}$ F for three weeks only. These fruits were maintained in a very good condition in low temperature and lasted for another ten days when they were transferred to room temperature for unavoidable reason.

During storage in room temperature the fruits gradually lost in weight and there was a corresponding loss in weight of their skin and quantity of juice. The weight of the pulp, solid matter of the juice, its specific gravity and total acid content slightly increased within that time. There was very little change in the total sugar within two weeks although a significant rise in the Vitamin C content was observed within the storage period.

In  $36^{\circ}$ - $38^{\circ}$ F the behaviour of the fruits was similar to those kept in room temperature but the changes were less pronounced.

**112. Studies in the physiology of fruits and vegetables. III.—Storage of Potatoes.**

J. K. CHOUHDURY and HARIDAS BANERJEE, Calcutta.

Red Round and Royal Kidney, the two well-known varieties of potatoes of West Bengal, were stored in different temperatures, viz., normal ( $78^{\circ}$ - $100^{\circ}$ F),  $56^{\circ}$ - $65^{\circ}$ F and  $36^{\circ}$ - $38^{\circ}$ F to study their storage requirement and to observe some of the changes that take place in the tubers. With the same object in view some of them were also treated with  $\text{KMnO}_4$ ,  $\text{HgCl}_2$  and paraffin and others were kept either immersed in dry sand or in close earthen-wire pots (unglazed) with a small quantity of lime in them as a dehydrating material.

The low temperature of  $36^{\circ}$ - $38^{\circ}$ F with R. H. 80-85% preserved the potatoes in good condition for 7-8 months with the minimum of loss in weight particularly of the medium sized ones of both the varieties. In  $56^{\circ}$ - $65^{\circ}$ F the tubers began to sprout within a month with consequent loss in weight. In normal ( $78^{\circ}$ - $100^{\circ}$ F) temperature, on the otherhand most of the treated and untreated potatoes were infected with fungus which they carried within them, so that they could not

be preserved for more than a month. The potatoes that remained in pots and sand preserved better than those that remained exposed to normal temperature. The water content of the tubers did not undergo any significant change under the storage conditions.

**113. Studies in the physiology of fruits and vegetables. IV—Metabolic changes in Fazli mangoes during development and storage.**

J. K. CHOUDHURY and HARIDAS BANERJEE, Calcutta.

'Fazli' mangoes were collected from the Government Horticultural Station, Krishnagar and also from Maldah (West Bengal) at an interval of 7-10 days during their development from a stage before store formation to full maturity. They were stored in normal (83°-94°F), 62°-96°F and 36°-38°F to study their keeping qualities and chemical changes viz., acid, sugar, pH, alcohol soluble and insoluble matters, dry weight of the pulp etc., during development and storage. They were also treated, in room temperature, with 2-4-D and N.A.A. in two doses of 1000 P.P.m. and 500 P.P.m.

In 36°-38°F all the fruits in different stages of maturity, lasted from 3-4 weeks, but they become unmarketable due to increase in acidity, loss of flavour etc. Mature fruits could be preserved for 14-19 days and 10-14 days, respectively, in 62°-69°F and room temperature and due to decrease in total acid and increase in total sugar in storage they developed marketable qualities. 2-4D in 1000 p.p.m. increased the storage life of the mature fruits by over a week in room temperature.

During development sucrose did not appear until the fruits were mature. From storage behaviour and chemical analysis best time for plucking the fruits appeared to be a stage immediately before appearance of sucrose in them.

**114. Comparative studies on the rates of pollen tube growth of the two cultivated jute species (*Corchorus olitorius* Linn and *C. capsularis* Linn) *in vitro*.**

R. M. DATTA, Calcutta.

Investigations on the comparative rates of growth of the pollen tubes *in vitro* in jute species showed an initial rapid growth in the first hour of dusting followed by a slow rate of growth in the next half an hour, after which the growth practically ceased. The above was the general nature of growth irrespective of the species. But the rate of growth was found more in *Olitorius* than in *Capsularis*. The maximum length of pollen tube after the same period of 90 minutes was found in *Olitorius* in all the samples. Comparative growth rates are plotted in the graph and the technique of growing the pollen grains in the culture medium is given.

**115. Pharmacognostic studies on the leaves of *Myrtus communis* Linn.**

S. C. DATTA and D. D. DATTA, Calcutta.

The leaves of *Myrtus communis* L. have been found to be sold in the Indian market under the name Indian Buchu and has been reported to be used by the manufacturing concerns for the preparation of tincture and infusion "Buchu". According to British Pharmaceutical Codex, the source of "Buchu", is the dried leaves of *Barosma betulina* (Thunb.) Bartl. and Wendl. and as such the preparations of Indian Buchu as stated above are considered unacceptable. Moreover several cases of poisoning from the oil obtained from the leaves of *Myrtus communis* L. have been reported by Barker and Rowntree (Bull. Joh. Hopkins



Host., 1918, 29, 215) and this leads to a consideration of the toxicity of the preparations of Indian Buchu.

The paper describes pharmacognostic characters of the leaves of *Myrtus communis* L. and a quick test for distinguishing Indian Buchu preparations from original Tincture Buchu has been described. This test depends upon the formation of a black precipitate with Iron complex salt in case of *Myrtus* preparations whereas genuine Tinct. Buchu does not respond to this test. The two tinctures also show different fluorescence under ultra-violet light.

The bactericidal property against *Staph. aureus* was markedly exhibited in vitro by Tinct. *Myrtus communis* while Tinct. Buchu had a doubtful bactericidal action on the same organism.

**116. Amino acid content in different parts of the germinating rice embryo by paper partition chromatography.**

T. M. DAS, Calcutta.

The study of changes of amino acid content in different parts of the germinating embryo of rice var. Rupsail was made. Free or soluble amino acids were extracted from different parts of embryo e.g., coleoptile, root, scutellum and different portions of endosperm by water at low temperature. Amino acids were present in all parts of the rice embryo except in husk. The number of amino acids in dry embryo were few with low Rf values, but with the increase of duration of extraction more amino acids were extracted with higher Rf value; this was possibly due to the hydrolysis of amino acids present in the tissue. With the increase of the age of the embryo the number of amino acids also increases particularly in the case of coleoptile and root. A large number of amino acids were found out in the endosperm and they were identical with those present in coleoptile, and their Rf values were identical with those of Aspartic acid, Asparagine, Glutathione, Glutamic acid, Arginine, Ornithine, Cystine, Tyrosine, Glycine, Tryptophan, Amino butyric acid, Lysine, Valine.

The scutellum tissue of 96 hours old embryo contained at least 5 to 6 amino acids and they were identical with those of present in the endosperm, but in the dry scutellum of non-soaked grain a few were extractable by short or long duration of extraction which possibly indicated that these amino acids were migrated from the endosperm tissue during the later period of the hydrolysis of the grain.

**117. Geotropism of Rice Embryo in relation to Carbohydrate, Vitamin and auxin supply.**

T. M. DAS, Calcutta.

One of the chief factors that determine the pattern of root-growth under the soil and shoot-growth in the air is the earth gravitational field. A series of investigations have been carried out on the back ground of recent developments in this topic.

In the germinating embryo of rice var. Rupsail, the carbohydrate of the endosperm has been proved to be the major factor for receiving geotropic stimulus by the root system. It has also been noted that without any participation of the coleoptile, the root can synthesize its own auxin for tropism in which only the endosperm plays the indispensable role. In the compound medium of sucrose, 3-indolyl acetic acid and thiamine segments of root tips are capable of exhibiting normal geotropic response. From several observations it has been postulated that just after the excision of the root tip some factor X, essential for exhibiting

geotropic response, may be present in the root tip; the quantity and strength of this factor alone is not enough to produce geotropic curvatures and for which addition of low concentration of IAA or sugar is essential. In the excised root tips the factor X is either rapidly used up or is destroyed and is not being replaced while root tips are being detached from the aerial part of the plant and starved for a few hours in distilled water culture; this is evident from the negative result of the addition of IAA after 24 hours of excision. The seat of this factor is possibly in the endosperm and also in the scutellum. It has been noticed that the geo-sensitiveness of root tips is amplified if they are allowed to be attached to a fraction of the scutellum. The chemical nature of the factor X is very likely to be different from those of sugars, IAA or thiamine.

#### 118. Response of an early-winter Rice to short photoperiod.

T. R. DUTTA (Agartala) and G. MISRA (Cuttack).

The effects of 8-hour (8 A.M. to 4 P.M.) short photoperiods have been studied in T.1145 (a selection of Usha of Puri district, Orissa), an early-winter variety of rice in pot culture experiments. Of the six experimental sets, one was kept as controls under the natural day length and the rest five were subjected to short-day treatment one after another at different ages of 10, 20, 30, 40 and 50 days respectively for a period of one month in each set after which the treated plants were grown in the open space along with the controls till the time of harvest. There was conspicuous earliness in all the short-day treated sets, the maximum earliness being in the plants receiving the treatment at the youngest age of 10 days. The degree of earliness gradually decreased with increase in the age of the seedlings at the time of treatment initiation. The grain yield showed parallel results with the length of the vegetative period in that the yield was the least in the earliest flowering plants gradually showing an increasing value with later flowering plants remaining always at a lower level than the control plants. Excepting the number of panicles which showed higher values in the seedlings receiving short days at earlier stages, the other components of yield like the number of spikelets and grains per panicle, the percentage seed setting and the one thousand grain weight were generally less in the seedlings which were subjected to short days at the younger ages of 10, 20 and 30 days.

#### 119. On the effect of Electricity on *Vinca* seedlings.

(MISS) C. P. GODAVARI, Annamalaiagar.

1. Experiments on the influence of weak electricity of the value of 2.5 amperes on the seedlings of *Vinca* were done.
2. Six culture jars were prepared for the purpose and out of which three were treated as experimental.
3. The experimental seedlings were daily treated with electricity precisely for five minutes.
4. After a fortnight, readings were taken with regard to the length of root and shoot system.
5. It was observed that the root system in the experimental plants was very much stunted and hence stout and there was no production of tertiary rootlets whereas in the control production of the same was conspicuously abundant.
6. This observation confirms those made by Singh on the seedlings of *Cicer arietinum*.
7. But the present observation differs from that made by Singh in having also a stunted shoot system.



**120. Some Observations on the Root Development in the Detached Leaf of *Urtica dioica* L.**

S. C. GUPTA, Nainital.

Detached leaves of *Urtica dioica*, when kept in tap- and distilled- water in the light at room temperature (18°-22°C), developed callus on the cut surface and later formed roots in 5-9 days. These detached leaves could be kept in healthy condition on tap- or distilled- water for more than 10 weeks.

The detached leaf with its own root system is capable of living for a long time and carries on most of its activities as a miniature plant. The observations support the views of Mrs. Arber in favour of partial shoot theory of the leaf.

Secondary growth has been observed in the vascular bundles of petiole and midrib of detached leaves after about 6 weeks.

**121. Physiology of pollen tube growth—effect of sugars.**

B. M. JOHRI and I. K. VASIL, Delhi.

The effect of several sugars (sucrose, dextrose, fructose, mannose, rhamnose, raffinose, lactose and galactose) and a sugar derivative (mannitol) on the germination of pollen of *Brassica nigra* (T.257), *Solanum melongena* (round purple 5311-1-1), and *S. tuberosum* var. *phulwa* has been studied. The addition of 0.01% boric acid gives better percentages of germination and longer tube lengths.

*Brassica nigra* (T.257)—In 7.5-10% sucrose, germination is 40% and the tubes are 2520 microns long; with boric acid germination increases to 65% and tube length to 3969 microns. Relatively poor germination and smaller tube lengths are obtained in dextrose, rhamnose and mannose while there is no germination in galactose and fructose.

*Solanum melongena* (round purple 5311-1-1)—With 1.25-2.5% sucrose, germination is only 17% and tubes only 570 microns long; addition of boric acid increases the germination to 74% and tube length to 4708 microns. Lactose, raffinose, dextrose and fructose give germination percentages and tube lengths very similar to those in sucrose. In mannose, rhamnose, galactose and mannitol, germination is very poor.

*Solanum tuberosum* var. *phulwa*.—There is no germination in 7.5% sucrose but with the addition of boric acid 80% of the grains germinate and produce tubes up to 3240 microns. In galactose, germination is only 6% and 288 microns long tubes are formed. However, with boric acid germination is raised to 67% and the tube length to 3230 microns. Dextrose gives 18% germination and 428 microns long tubes but with boric acid here also the germination is raised to 67% and tubes grow to 1179 microns in length. There is no germination in fructose.

The effect of sugars on pollen germination varies from species to species or variety to variety. The suitability of a particular sugar or sugar derivative does not seem to bear any relation to its natural occurrence in plants. For example, pollen grains germinate quite satisfactorily in lactose, but so far there does not seem to be any authentic record of its occurrence in plants. On the other hand, fructose, which is so common in plants, proved to be rather unsatisfactory.

**122. Storage and viability of pollen grains under controlled conditions.**

B. M. JOHRI and I. K. VASIL, Delhi.

A brief report on suitable conditions of storage for the pollen of *Arachis hypogaea* (T.9), *Brassica nigra* (T.257) and *Solanum tuberosum* var. *phulwa* is presented here. Pollen was stored in closed petri dishes, gelatin capsules and

open glass vials at room temperature and in a frigidaire at variable relative humidities (R.H.).

*Arachis hypogaea* T.9—When stored at 3°C, 66% R.H., the pollen remains viable for 15 days with 43% germination, and the tubes reach a length of 576 microns. At 30°C, after 15 days of storage in a closed petri dish (R.H. 63-69%), 68% pollen germinates and the tubes attain a length of 4,320 microns. Storage at 26°-31°C, over 0, 31-40, 66 and 94% R.H. did not give satisfactory results.

*Brassica nigra* T.257—At room temperature (16°-20°C), when stored in gelatin capsules (26-70% R.H.), the pollen remains viable for six days and up to the third day it shows 42% germination and 780 microns long tubes. At 5°-8°C, in gelatin capsules (63-69% R.H.), viability extends to 18 days and on the 15th day germination is 52% while the tubes are 576 microns long. At the same temperature but 66% R.H.), viability is retained for 41 days, after 15 days of storage 48% of the pollen germinates producing 438 microns long tubes. Storage at room temperature in 0, 31-34, 66 and 94% R.H.; and over 0, 40 and 94% R.H. in frigidaire (5°-8°C), was unsatisfactory.

*Solanum tuberosum* var. *phulwa*—At room temperature (15°-31°C), the pollen remains viable for 54 days over 0% R.H. and 18 days over 34% R.H. At 5°-8°C they retain viability for 59 days over 0% R.H., 70 days over 40% R.H. (on the 59th day 34% of the pollen germinated producing 2,007 microns long tubes), and 44 days over 66% R.H. (38% germination and 2,160 microns long tubes). Viability of pollen stored at 67 and 94% R.H. at room temperature, and 94% R.H. at 5°-8°C was unsatisfactory.

With the increase in relative humidity beyond 40%, the viability gradually falls. Generally the pollen stored over calcium chloride (0% R.H.) remains viable for a shorter period than those stored over 34-40% R.H. In higher humidities, i.e. beyond 66%, bacteria and fungi attack the stored pollen within about a week and render the samples unfit for any further tests.

### 123. Trace element requirements of two halophilic blue-green algae.

V. KRISHNA PILLAI, Mandapam.

In an attempt to examine the possibility of maintaining adequate algal growth in shallow saline tracts two blue-green algae viz., *Oscillatoria subbrevis* Schmidle and *Spirulina subsalsa* Ocrst., characteristic of such environments, were studied in laboratory cultures. It was found that both the species, particularly the former, exhibited normal growth even when the salinity of the outer medium increased to 8-0%, provided optimum concentrations of the elements Mn, B, I and Fe and traces of Mo and Cu were present in the medium along with the major nutrients.

In view of the fact that the salinity of the water in the lagoons is subject to abnormal increase, the data obtained are of significance in attempts to utilize the lagoons for fish cultivation.

### 124. Effects of some plant growth substances on an early variety of Rice.

G. MISRA and G. SAHU, Cuttack.

An early variety of rice (N-136) was subjected to the treatment of three different synthetic plant growth substances, i.e.  $\beta$ -Indolyl acetic acid (IAA),  $\alpha$ -Naphthyl acetic acid (NAA) and 2, 3, 5-Triiodobenzoic acid (TIBA). The seeds were soaked in 500ppm, 250ppm and 100ppm of each solution for 72 hours and then sown in earthenware pots. The plants were given weekly foliar spray with the corresponding solutions in which the seeds were previously soaked, beginning from 3 week

old seedling till the time of flowering. Earliness in flowering is observed in plants treated with TIBA and delay in the plants treated with IAA and NAA. Maximum delaying effect is obtained in case of plants treated with 500 ppm. of NAA and maximum earliness with plants treated with 250 ppm. of TIBA. Plants treated with TIBA solutions show a conspicuously better vegetative growth while plants treated with auxins show a tendency of late flowering and less vegetative growth with a gradual increase in the concentration of the auxins. Grain yield is higher in plants treated with IAA and TIBA, highest being observed in the plants treated with 500ppm IAA solution. A higher grain yield in plants treated with IAA is due to a combination of several characters favourably affected in a cumulative manner, such as greater number of panicles formed per plant, longer panicles, higher per cent seed set, based on the grains and spikelets per panicle, and increase in grain plumpness. The increase in grain yield in plants treated with TIBA is mainly due to an increase in the number of panicles and their length.

**125. Morphogenetic effects of various synthetic hormones on the gemmae and thalli of *Lunularia*.**

S. NARAYANASWAMI, Delhi.

Previous investigations (La Rue & Narayanaswami, 1955) have shown that growth hormones were among the chemical factors of greatest morphogenetic potential and that Indole-acetic acid is formed in tips of thalli of *Lunularia* (unpublished). It was decided to survey the effects of a number of synthetic growth hormones supplied by the Dow Chemical Company, U.S.A., on the liverwort gemmae and thalli. Some of the hormones tried were: NAA, IAA, IBA, 2, 4-D, phenyl-butyric, 2, 4, 5-trichlorophenoxy-acetic acid,  $\alpha$ -O-chlorophenoxy-propionic acid etc.

Treatments with IAA, NAA and IBA in different concentrations and growth on these and other hormones caused the gemmae to develop unusual and bizarre morphological patterns. Growth effects worthy of record are (1) production of adventitious buds on both upper and lower surfaces and their growth into succulent upright lobes which soon started expansion of their top into thalli or 'feet',

(2) loss of apical dominance and concomitant development of buds from the general surface of the gemma,

(3) Inhibition of normal growth of thalli from growing points,

(4) extensive elongation of the body of the gemma and

(5) absence of *splitting* (double-decker effect) as shown by other chemical treatments.

Hormone treatments of the growing thalli caused an abrupt narrowing of the thallus tips, drawn out into twisted 'snouts'. The gemma cups grew into enlarged bowls with their fringed margins reflexed. The pores stood upright like hollow tubes and funnels and rhizoids were induced from upper surfaces and from within the gemma cups.

**126. On the effect of musical sound on the growth of Cabbage.**

V. NINAN, Vellore

Twenty-five seedlings of *Brassica oleracea* (Cabbage) were excited for 15 days for 10 minutes in the morning and 10 minutes in the evening by playing the following notes on violin :

Sa	Ri	Ga	Ma	Pa	Ma	Pa
Ma	Pa	Dha	Pa	Ma	Pa	Ma
Sa	Ri	Ma	Ga	Ri	Ri	Sa
Sa	Ri	Ga	Ma	Pa	Ma	Ri

A set of another twenty-five seedlings of similar height and vigour as the experimental ones, were maintained as control and similar treatments in respect of irrigation and hoeing, etc., were offered to both the batches of experimental and control seedlings. The results obtained were interesting in so far as all the experimental seedlings were found to be much taller, more vigorous, more leafy along with production of greater leaf-area than those of the control seedlings.

**127. Effect of Maleic Hydrazide on the weed *Heliotropium indicum*.**

B. PANIGRAHY (Berhampur) and G. MISRA, Cuttack.

The weed *Heliotropium indicum* Linn. was subjected to a foliar spray of an aqueous solution of maleic hydrazide in the concentration of 1,000, 500, 250, 100 and 50 p.p.m. (parts per million). Plants treated with 1,000, 500 and 250 p.p.m. were ultimately killed. During the process of killing various morphological signs appeared. There was yellowing of the leaves followed by drying up of the lamina which proceeded from the tips marginally towards the base and later on intruding into the mid veins. With the collapse of the green leaves the photosynthetic mechanism was at a standstill. There was an immediate arrest of the growing apex resulting in the stunted growth of the treated plants. The formation of new vegetative buds were stopped and these which were formed earlier before the treatment gradually shrivelled up after treatment. The inflorescences produced in the treated plants did not bear flowers and seed setting was thus entirely prevented. The development of the xylem vessels in the stems was very poor. Plants treated with 100 p.p.m. died after a very long time while those treated with 50 p.p.m. contrary wise produced a much luxuriant growth in all respects in comparison to the controls.

**128. On the effect of Ultra-violet ray on the growth of Tapioca.**

S. PANNIRSELVAM, Annamalainagar.

Healthy selected cuttings of Tapioca (*Manihot utilisima*) were exposed to ultra-violet ray emitted from Hanovia fluorescence ultra-violet ray lamp from a distance of 9" for varying periods of 5 minutes, 10 minutes, 15 minutes and 20 minutes. These treated cuttings were planted separately in pots. Regular comparable controls were also maintained. Their germination and growth performance were studied weekly.

As a result it has been found that 5 minutes ultra-violet ray treated cuttings have shown no significance over the control. But the growth performance of the other three ultra-violet ray treated cuttings was found to be superior to the control. Out of these the 15 minutes ultra-violet ray treated cuttings have yielded the best performance in respect of height and leafiness. Further work is in progress.

**129. Effect of Phenyl Acetic Acid on the growth, maturity and yield of Ragi.**

S. K. PILLAI, C. O. VARGHESE and A. K. MUKHERJEE, Pilani.

Seeds of Ragi, variety K.1., were presoaked for 24 hours in aqueous solutions of PAA of 0.2, 0.4, 0.8 and 1.0 ppm concentrations. Controls were soaked in tap water. The plants were reared in pots. During the vegetative period of the plants the acid solutions were sprayed on the aerial parts at fortnightly intervals.

The ragi plants were considerably influenced by these concentrations of the acid, the general effect being promotion of both vegetative growth and reproductive development, which increased with concentration.

Height, number of leaves and dry matter were progressively greater with the treatments, as also earlier flower initiation, the treatment with 1.0 ppm flowering 12.27 days earlier than the control. Tillering and production of lateral branches were reduced by the treatments.

Through the number of panicles and 1,000 grain weight were lesser, the length of panicles, weight of grains and number of grains and spikelets and percentage of grain set as observed in the main panicle only (42.5% more than control in 1.0 ppm) were all significantly greater in the treated plants.

Analysis of variance showed that the treatments were significant at 1% level.

**130. Effect of presoaking seeds in some growth regulating substances on the growth of the root and shoot portions of the seedlings.**

S. K. PILLAI and P. K. P. KURUP, Pilani.

The effect of presoaking seeds of four cereals and two pulses in seven concentrations ranging from 0 to 1,000 parts per million (ppm) of three growth regulating substances, 3-Indolylacetic acid (IAA), B-Naphthoxyacetic acid (NoXA), and -Naphthaleneacetic acid (NAA) on the growth of the root and shoot portions have been recorded. IAA and NoXA are found to be promoters of growth by and large, while NAA is mainly a retarder. Lower concentrations of IAA and NoXA promote the growth of these organs while the higher ones gradually retard. Between the root and shoot portions, the acids promote the growth of the former more than that of the latter. The effect of the three auxins is different on the different seeds experimented upon. Taken generally the cereals are promoted more than the pulses. Higher concentrations of the acids produce swellings of the hypocotyls of the pulses which are accompanied by longitudinal fissures at the very high ones. These swellings disappeared when dehydrated indicating that they were caused by greater absorption of water and consequent extension of the walls. The auxins are found to promote growth of the cells in the plastic stage along the long axis of the organ at low and of the permanent cells along the broad axis at higher concentrations. The pulses are more susceptible to the auxins and their plumules are inhibited at high concentrations.

**131. Growth and yield of Sorghum as affected by treatment with IAA and NoXA.**

S. K. PILLAI and P. K. P. KURUP, Pilani.

One set of Sorghum seeds, variety H.473, was treated with aqueous solutions at 50 ppm concentrations of IAA and NoXA for 24 hours and sown in pots and the plants raised therefrom. Another set was sown without any such pretreatment. Both the sets of plants were treated with the acid solutions during the vegetative period by adding the solutions to the soil at weekly intervals. Untreated controls were also maintained.

It was found that pretreatment produced no increase in height, except that with IAA, while leaf and tiller production was greater. Both the treatments with NoXA delayed ear emergence and did not favour growth. Straw production is greater in both while grain production is slightly better only with IAA and is depressed by NoXA. Between the two acids IAA is better than NoXA for Sorghum.

**132. Further studies on the effect of musical sound on the growth of plants.**

(Miss) STELLA PONNIAH, Annamalainagar.

Experiments were conducted by playing the single note *pa* with the aid of violin on the seedlings of chillies and tobacco. At first it appeared that the treatment had an inhibitive effect on the experimental seedlings as compared to the control; but a closer examination revealed that the production of leaves was generally greater in the excited plants and the unit area of the leaf too was likewise greater. It was only after the leaves had matured that the excited plants grew taller than the control. The flowering was much earlier in the experimental plants and the number of flowers per inflorescence was likewise greater. It is curious to note that the experimental tobacco plants were less hairy and their nicotine content was generally higher than the control.

**133. Further observations on histological changes in plants evoked by the musical excitations of violin.**

(Miss) STELLA PONNIAH, Annamalainagar.

Seedlings of Tobacco were excited with the single note *Pa* and those of *Petunia* by playing *Maya-malava-gaula-raga* on violin. As results of these excitations certain remarkable histological changes have been observed as compared to the control as shown under.

*Tobacco*: Stomata per unit area was 40% higher; Palisade cells were longer and broader to the extent of 40%; the number of chloroplasts in the mesophyll cells was much greater and their size was bigger and as such they were more closely packed. The production of starch as determined by Iodine test was likewise more profuse.

*Petunia*: The number of hairs and stomata per unit area were about 40% higher. The general thickness of the leaf was 20% thicker and the palisade length was over 40% greater than the control.

**134. Observations on the germination of seeds obtained from musically excited plants.**

(Miss) STELLA PONNIAH, Annamalainagar.

Experiments on germination of seeds from musically excited plants of *Mimosa pudica* and *Petunia hybrida* were conducted in petridish and pot-cultures and also in nursery beds in the field. In each case it was found that the germination percentage was far superior (of the value of not less than 100%) in the seeds derived from the experimental plants to those of the control. Subsequent seedlings were also likewise much hardier and stronger.

The seedlings so obtained and when they had attained the height of about 3" when transplanted in the field, were far superior. It was found that the mortality of the transplanted seedlings was much higher in the control than the experimental ones. Even subsequent growth-performance and production of fruits and seeds were also superior.

**135. On factors influencing fruit-set and sterility in Arecanut (*Areca catechu* Linn.): II. Germination of pollen grains and growth of pollen tubes under the influence of certain auxins, vitamins and trace elements.**

V. RAGHAVAN and H. K. BARUAH, Gauhati.

In an earlier paper (*J. Indian bot. Soc.*, 1956, 35: 139-151) the authors have indicated that the considerable extent of sterility in arecanuts (*Areca catechu* Linn.)

is mainly due to failure of pollination and failure of pollen grains to produce sufficiently long tubes resulting in lack of fertilization. It was also noted that the length of the pollen tubes produced in nutrient media of different carbohydrates is not sufficient to reach the ovule, the length of the style varying from 0.8-1.3 cm. The present paper, therefore, describes the results of the experiments on the effects of certain auxins (3-indoleacetic acid, 3-indolebutyric acid, 3-indolepropionic acid and 2-naphthaleneacetic acid), vitamins (para-aminobenzoic acid, ascorbic acid and inositol) and trace elements (cobalt chloride, boric acid, lithium chloride, manganese sulphate, ammonium molybdate, zinc sulphate and auric chloride) on the extent of germination of the pollen grains and the rate of elongation of the pollen tubes *in vitro*.

The percentage of germination of the pollen grains was found to vary with the nutrient factor used: for instance, with boric acid, 3-indolebutyric acid, auric chloride, 2-naphthaleneacetic acid and manganese sulphate nearly 90 per cent or more of the grains germinated in certain concentrations of the nutrients, whereas with zinc sulphate, and 3-indolepropionic acid, even lower concentrations did not appreciably enhance the extent of germination. With other nutrients an average germination of 80 per cent was obtained in varying dilutions. The average length of the pollen tubes in 3-indolebutyric acid, ascorbic acid, cobalt chloride, lithium chloride, manganese sulphate, ammonium molybdate, and zinc sulphate was nearly two or three times the length obtained in the control, whereas the maximum length attained by the pollen tubes ranged from 1800-2400  $\mu$ . The most significant results were, however, obtained with boric acid, where the average length of the pollen tubes was nearly four times that in control, with a maximum length of 2900  $\mu$ . No appreciable increase in the length of the pollen tubes was obtained in varying concentrations of 3-indolepropionic acid and inositol.

The probable method of spraying the palms with the appropriate stimulants during the reproductive phase to ensure a uniformly high rate of fruit-set in the palms is indicated.

### 136. Factors concerned in the secondary growth in the petioles of the leaves of *Ipomoea batatas* Lamk.

B. SAMANTARAI and T. KABI, Cuttack.

Secondary growth takes place in the petioles of herbaceous dicot leaves when they are isolated and rooted although no such growth is seen when they are attached to the plant. By a series of experiments with isolated leaves of *Ipomoea batatas* with the application of  $\beta$ -indolyl butyric acid (IBA) and Maleic hydrazide (MH) it was found that IBA induces root production and secondary growth whereas MH prevents both the processes.

Another series of experiments were performed with the attached leaves. Rings of all the living tissue external to the xylem were removed from the stem just above and below the nodes, where the leaves were attached. These attached experimental leaves were fed with (1) IBA solution, (2) MH solution, (3) Sucrose solutions and (4) Asparagine solution through their cut tip. Again, some of the leaves were first fed with IBA and then MH and certain others in the reverse order i.e., first MH and then IBA. By ringing the stems just above and below the nodes translocation from the leaves to the different parts of the stem was prevented. These experiments revealed that leaves fed with IBA and the controls showed secondary growth whereas those fed with MH did not show any distinct secondary growth. Moreover, these leaves which were fed with both IBA and MH showed no secondary growth or very little, if at all. Leaves fed with sucrose and asparagine showed secondary growth. It is concluded from both the series of experiments that auxin whether native or applied is the main factor in determining the secondary growth in petioles and probably in stems of dicots.



**137. Secondary growth in the petioles of the leaves of *Argyrea* and *Acalypha* and the partial shoot theory of leaf.**

B. SAMANTARAI and B. K. NANDA, Cuttack.

Isolated leaves of *Argyrea speciosa* Sweet and *Acalypha densiflora* L. were treated with  $\beta$ -indolyl butyric acid (IBA) at concentrations of 5 parts per million (p.p.m.) and 2.5 p.p.m. respectively for a period of 24 hours. Leaves of two different ages were selected in each case. After treatment they were cultured in water till the emergence of roots after which they were planted in soil. For each treatment there were detached as well as attached controls. The detached controls did not root at all. It is found that in *Argyrea* in very old attached controls secondary growth takes place only in the bundles by the activity of fascicular cambium and interfascicular cambium is not formed, whereas in the rooted leaves due to the activity of fascicular and inter-fascicular cambia and accessory cambia a type of anomalous secondary growth takes place which resembles the pattern in the stem. In *Acalypha* the controls never show any secondary growth whereas the rooted ones show a type of secondary growth which has a tendency towards the pattern in the stem. These findings support the partial shoot theory of leaf elaborated by Arber.

**138. Effect of maleic hydrazide on the rooting response of some stem cuttings with distinctive anatomy.**

B. SAMANTARAI and H. PATTNAIK, Cuttack.

Stem cuttings of *Boerhaavia diffusa* L., *Gomphrena globosa* L. and *Dracaena angustifolia* Roxb. were treated with aqueous solutions of  $\beta$ -indolyl butyric acid (IBA), maleic hydrazide (MH) and IBA+MH. The concentration of IBA was 100 p.p.m., as it was found to be the optimal concentration for rooting response for these twigs. The concentration of MH applied were 100, 50 and 20 p.p.m. Controls were kept in water. The treatments lasted for 24 hours and subsequently washed and cultured in tap water under humid conditions under diffused light.

It was found out that the cuttings treated with IBA produced copious roots whereas those treated with MH had no roots at all. However cuttings which were previously treated with IBA and subsequently with MH produced some roots at lower concentrations of MH. This low rooting response is ascribed to the inhibitory effect of MH on the formation of root primordia.

**139. Factors concerned in the control of vascular pattern of induced roots in dicot leaves.**

B. SAMANTARAI and S. K. SINHA, Cuttack.

The vascular pattern in the adventitious roots is usually very much variable in a plant. In order to ascertain the factors that control the variation in the adventitious roots, investigations were made in the induced roots in isolated leaves of *Ipomoea batatas* Lamk., *Impatiens balsamina* L. and *Basella alba* L. The leaves were subjected to following treatments before induction of roots. (1) The leaves were treated in aqueous solution of  $\beta$ -indolyl butyric acid (IBA) at 2.5, 5, 10, 20, 50 and 100 parts per million (p.p.m.). (2) They were fed with different doses of sucrose and ammonium sulphate for supplying sugar and nitrogen respectively. (3) They were also fed with these substances in addition to the treatment with IBA. at 5 p.p.m. (4) They were subjected to starvation for varying periods prior to treatment with IBA.



The vascular pattern of these adventitious roots were as follows :—

(1) Roots induced by IBA showed higher number of vascular strands than the roots in the control leaves. The number increased along with rise in concentration.

(2) Roots resulting out of sugar and nitrogen feeding also possessed greater number of strands than the control ones.

(3) Supply of sugar or nitrogen in addition to treatment with IBA produced greater number of roots with higher number of strands than with hormone-treatment alone. Sugar was, however, more effective in this respect than nitrogen.

(4) Starving the leaves prior to treatment with IBA caused the production of roots with smaller number of vascular strands.

It is therefore, concluded that auxins and food especially sugar are chiefly responsible for the control of vascular pattern in the adventitious roots of isolated leaves.

#### 140. Influence of IAA on the depressing effect of sodium sulphate solution on root-growth in wheat.

M. N. SARIN and I. M. RAO, Agra.

Earlier studies by the authors on the effect of supplying different concentrations of sodium sulphate solution to seedlings of Wheat C. 591 indicated that root-growth was adversely affected by concentrations of 0.6% and above. The present investigation was undertaken with a view to utilize the stimulating influence on root-growth of low concentrations of IAA in nullifying the retarding effect of 0.6%  $\text{Na}_2\text{SO}_4$  solution.

In the beginning, the seeds were soaked in varying concentrations (7, 5, 3, 1, 0.5, 0.1, 0.05, and 0.01 ppm.) of IAA for 24 hours and sown with a supply of distilled water, in order to find out the concentration which accelerated the root-growth. 5 ppm. and above of IAA, retarded the growth by about 11% compared to control which was statistically significant; 0.1 ppm. increased the root-growth by about 20%. The results are in conformity with the conclusions of Thimann and Lane (1938).

Two lots of wheat seeds were soaked for 24 hours, one in the 'stimulating' concentration of 0.1 ppm. of IAA, and the other in distilled water and sown separately on the filter paper cones inserted in the tubes supplying (i) distilled water and (ii) 0.6%  $\text{Na}_2\text{SO}_4$  solution.

Total root-growth per seedling at the end of 4 days amounted to : seeds (1) pre-treated with distilled water and (i) sown in water (Control) : 273.6 mm. (ii) sown in 0.6%  $\text{Na}_2\text{SO}_4$  solution : 237.5 mm.; (2) pre-treated with 0.1 ppm. of IAA and (i) sown in water : 305.9 mm. and (ii) sown in 0.6%  $\text{Na}_2\text{SO}_4$  solution : 270.5 mm. Thus the accelerating effect of the IAA on growth amounted to 11.8% (statistically significant) of the control ; the depressing effect of 0.6% sodium sulphate (with pre-sowing soaking of seeds in water) was 13.1% (significant) and the two treatments combined (item (2) ii) resulted in root-growth almost equal to that of the control, indicating that the retarding effect of the  $\text{Na}_2\text{SO}_4$  solution could be nullified by the stimulating effect of the IAA.

Several workers suggested that the accelerating effect of IAA could be due to increase in osmotic pressure or plasticity of cell-walls thus enhancing their capacity to absorb more water. Others have suggested that poor growth of plants in salt lands could be due to the osmotic effect of the high concentration of soil solution and not to the toxic effect of the solutes eg., chlorides, sulphates etc. The present investigation apparently supports the above views.

The possibility of improving growth of plants in salt-lands by using IAA in suitable concentrations has been discussed.

**141. Physiological studies on dormancy in Potatoes. I. Influence of synthetic hormones on inhibition of sprouting of two varieties stored under different storage conditions.**

M. N. SARIN and I. M. RAO, Agra.

With rapid increase in cultivation of potato crop in the plains in India during recent years, the problem of sprouting of tubers in storage is gaining great importance. Sprouting is considered to reduce the quality of tubers and also their weight. The present study was undertaken to find out the effect of synthetic hormones in checking sprouting under different conditions of storage.

Tubers of two varieties, Military Special and Phulwa, from the harvest of rabi crop 1955-56, were given pre-soaking treatment for 24 hours in 100 ppm. of (i)  $\alpha$ -naphthalene acetic acid, and (ii) 2,4-Dichlorophenoxyacetic acid and stored from 27th April 1956 to 24th August 1956 along with controls in (a) diffuse light and in (b) darkness, in an underground room in the Laboratory; the temperature was not controlled and remained above 30°C during the storage period. Tubers of Phulwa, pre-treated with NAA were also kept in a local cold-storage factory from 4th May 1956 to 1st September 1956. Weekly loss in weight as well as number of sprouts and total sprout-length at the end of storage period were noted for the laboratory experiment. Total sprouts were counted on the tubers kept in cold storage.

On fresh weight basis the total loss amounted in general to 5.4% for Military Special and 9.6% for Phulwa; the differences due to 'light' or 'darkness' and to the treatments were small. Compared to the control, in diffuse light, NAA reduced sprouting by about 76% in Military Special, while in darkness it tended to increase sprouting; the reduction in sprouting in Phulwa was nearly 47% both in 'light' and in darkness. 2, 4-D was less effective and erratic in its behaviour. NAA was also effective in checking sprouting of tubers (Phulwa) kept in cold-storage factory, the reduction being 27.5% of the control. The beneficial effect of NAA supports the results of workers in U.S.A.

Further studies with other chemicals are in progress.

**142. Permeability Status of Leaf Cells of Different Wheats.**

B. SEN and H. C. JOSHI, Almora.

The permeability status of leaf cells of 7 different strains of wheats at similar stages of seedling growth has been determined by measuring the changes in electric resistance of 3 cm. lengths of leaves. It has been shown (Sen, B., *Roy. Soc. Proc.* Vol. B 94, 1923) that the permeability of the cells of a tissue to ions can be correlated to the electric resistance of the tissue. Diminution of resistance indicates increased permeability to ions and *vice versa*.

After the resistance attained a steady value, 3 cm. of the different leaves were stimulated by the electric shock of constant intensity and the electric resistance of the stimulated leaves was measured. The percentage diminution of resistance due to similar electric stimulus was taken as a measure of permeability status of the leaf cells to ions.

The percentage diminution of resistance after a constant and similar electric stimulus was found to be different in different strains. It was 48.9% in N.P. 809; 50.1% in N.P. 798; 54.3% in Hy. 12; 54.9% in N.P. 52; 60.7% in N.P. 710; 60.8% in Yorkwin and 68.8% in Ph. 9-D. From these data it has been concluded that the permeability status of leaf cells of different wheat is different.

Earlier experiments (1955) showed that diminution of electric resistance induced by an electric shock of constant intensity was greater in rust susceptible varieties. It will be seen that the diminution of resistance observed in leaf of N.P. 809, one of the strains most resistant to different rusts is the least.

#### 143. Amino Acid Contents of Rust Resistant and Rust Susceptible Wheat.

B. SEN and H. P. SAH, Almora.

Using the descending chromatographic technique of Consden *et al* (1944) the amino acid contents of rust resistant and rust susceptible varieties of wheats have been determined. Seeds of highly rust resistant strain, N.P. 809 and of a very susceptible variety, Agra Local, were used for these experiments.

The extract of the material was prepared after the method described by Block *et al* (1952). Solvents used were (i) of Giri's butanol acetic acid-water (40:10:50) and (ii) of Draper and Pollard (1949) phenol-water (80:20).

Two dimensional chromatograms were prepared. Whatman No. 1 filter paper was used in this work. Spotting was carried out by means of calibrated micro-pipette. Chromatograms were run for 18 hours. 0.4% ninhydrine in 95% acetone was used for developing the colour. The cabinet used in this experiment was made in the Laboratory workshop.

Chromatograms of both N.P. 809 and Agra Local have given eleven spots. From the areas of the different spots, the contents of the different amino acids have been compared. It was found that compared to Agra Local, the contents of the following amino acids in N.P. 809 are less: dl-leucine, dl-isoleucine, dl-(beta) phenyl alanine dl-proline, dl-valine, dl-tryptophane, dl-methionine, l-tyrosine, dl (L) alanine spots, while concentrations of dl-threonine, l-glumatic acid, l-glycine, dl-serine and dl-aspartic acid are greater. Further work is in progress.

#### 144. Leaching of Amino Acids from Mustard T 102 Seeds.

B. SEN and H. P. SAH, Almora.

Experiments were undertaken to find out the nature and extent of the amino acids which leach out of the seeds of mustard T 102 when they are soaked in water.

1 lb. of seeds of mustard T 102 were soaked in 1 litres of glass distilled water for 12 hours. The seeds were taken out and the water was concentrated to 500 cc., 200 cc. of which was evaporated in a water bath nearly to dryness. Extract for spotting was prepared after the method of Richard J. Block *et al* (1952).

Descending chromatograms after the method of Consden *et al* (1944) have been prepared. These chromatograms show that fourteen amino acids (so far identified) have leached out of the seeds. These are: tyrosine, dl-alanine, dl-leucine and dl-isoleucine dl-valine and dl-methionine and dl-tryptophane, dl- $\beta$ -phenylalanine, l-glycine and taurine, l-proline, dl-lysine, dl-citruline and dl-serine. One spot appearing between dl-proline and tyrosine has not been identified. The leaching of tyrosine and alanine has been very marked.

#### 145. Amino Acid Contents of the Control and Vernalized Seeds of Colonial Barley.

B. SEN and H. P. SAH, Almora.

It has been shown by Sen and Srivastava (1956) that colonial barley gives a marked vernalisation response. Experiments were undertaken to find out the difference, if any, in the amino acid contents of vernalised and control seeds of colonial barley.

Different samples of colonial barley were chilled for different periods and these were placed on appropriate dates in the chilling cabinet so that the samples chilled for 8, 6, 4 and 1 weeks could be taken out on the same date. Control samples were germinated at room temperature to coleoptile lengths similar to the seeds chilled for different periods. The methods of Richard J. Block (1952) has been followed for the preparation of the extract.

Descending chromatographic technique of Consden *et al* (1944) has been followed. Giri's (1951) Butanol acetic acid, water solvent (40 : 10 : 50) has been used. Spotting was carried out by means of calibrated micro-pipette.

It has been found that (i) compared to seeds chilled for 1 week the contents of all the amino acids except proline are higher in control seeds, (ii) in seeds chilled for four weeks contents of only seven amino acids are higher in control seeds, (iii) in seeds chilled for 6 weeks the contents of the only four amino acids are higher in control and (iv) the seeds chilled for 8 weeks all the amino acids except cystine and threonine contents are higher in the vernalised sample which is approximately the period of chilling required for inducing maximum vernalisation.

#### 146. Cultivation of Tissue Fragments of Embryos and Seedlings of Control and Vernalised Seeds of Mustard T 102.

B. SEN and GYANENDRA VERMA, Almora.

It was shown previously (1947) that embryos isolated from vernalised seeds of mustard T 102 produced plants that flowered earlier than those from control seeds. Experiments to locate the region of embryo where changes induced during the process of vernalisation takes place, are reported.

Fragments from soaked embryos and from seedlings with 16 to 18 mm. hypocotyl of control and vernalised seeds of mustard T 102 were grown by the tissue culture method in sterile media. When these developed roots and leaves, they were planted in pots containing sterilised soil. For growth media glass distilled water, micro-concentrations of  $\text{Ca}(\text{NO}_3)_2$ , Boron and Manganese, and White's complete nutrient solution with and without sucrose were used. Results of these experiments show that: (i) even in glass distilled water considerable growth elongation and differentiation of tissue fragments of embryos and seedlings from control and unsplit vernalised seeds of Mustard T 102 takes place; (ii) the best growth is produced in White's complete nutrient solution; (iii) the combined growth of two or more fragments of hypocotyl is greater than that of the intact hypocotyl; (iv) polarity of tissue is maintained in all fragments, i.e., roots always emerge at the basal ends of the fragments; (v) growth rate of 2 mm. fragments of embryos or seedlings with apical meristem is greater in vernalised fragments; (vi) complete plants can be raised from 2 mm. fragments with apical meristem from embryos or seedling hypocotyl from both control and vernalised seeds; (vii) plants raised from 2 mm. fragments of seedling hypocotyl grown in White's nutrient solution flowered significantly earlier than those grown in glass distilled water and finally (viii) plants raised from 2 mm. fragments from vernalised embryos and seedlings flower significantly earlier showing that the changes induced during the process of vernalisation are confined to apical meristem of the embryos.

#### 147. Studies on the Pollen of Crop Plants—Barley, Sorghum, Teosinte and Strawberry.

B. SEN and GYANENDRA VERMA, Almora.

Results of experiments with twelve strains of Barley (*Hordeum vulgare* L.), seven strains of *Sorghum vulgare* Pers., one strain of Teosinte (*Euchlaena mexicana*

Schrad) and two varieties of Strawberry (*Fragaria vesca* L.) are reported. Barley, Sorghum Teosinte pollen could not be germinated in liquid media.

**Barley** : Maximum germination and growth of barley pollen was observed in media containing 25-27.5% sucrose and 1% agar. The maximum length of pollen observed varied from 620 microns, in T 5, to 200 microns, in T 155.

Micro-concentrations of calcium nitrate (10 p.p.m.), potassium nitrate (10 p.p.m.), boron (12 p.p.m.), manganese (0.1 p.p.m.), molybdenum (0.15 p.p.m.) and phenoxy compounds, 2, 4-D (2 p.p.m.), TLBA (2 p.p.m.) and OCPPA (0.02 p.p.m.) were found to stimulate growth of pollen tubes. Maximum stimulation was observed with manganese and molybdenum among the micro-elements and with OCPPA in case of the phenoxy compounds. Boron, however, did not produce any marked stimulating effect.

**Sorghum** : Best germinating medium for sorghum pollen was found to be 25 to 27.5% sucrose in 1% agar. The maximum tube lengths attained by pollen of different strains tried in 3-4 hours varied from 802 microns, in Milo 54, to 300 microns, in Martin's milo.

**Teosinte** : Teosinte pollen germinated best in 20% sucrose solution containing 1% agar. Germination started in 15 minutes and maximum elongation of tubes (960 to 1100 microns) was reached in 3 hours.

**Strawberry** : Good germination and tube elongation of strawberry pollen was obtained in 15% sucrose solution. In sugar-agar medium better germination and growth was obtained in 12.5% sucrose solution containing 0.5% agar. Pollen grains of Miller's Hybrid produced thicker and longer tubes (746 microns) than those of Perennial strawberry (295 microns).

#### 148. Tracer studies in the biochemistry of photoperiodism : The low intensity light process.

S. P. SEN, Calcutta.

Of the partial processes of the photoperiodic reaction the biochemistry of the dark and high intensity light processes in relation to  $\text{CO}_2$  fixation using  $\text{C}^{14}$  as the tracer has been described in previous communications. The low intensity light processes in which red light  $6600\text{\AA}$  nullifies the effect of the previous photoperiod and this effect in turn is reversed by light of the far red region  $7300\text{\AA}$  has now been studied.

The long day Wintex barley and the short day cocklebur were used. The effect of red and far red light applied  $6\frac{1}{4}$  hrs. after the commencement of the dark period, on the products of  $\text{C}^{14}\text{O}_2$  fixation in the dark period of the product of photosynthetic  $\text{CO}_2$  fixation in the previous light period has been studied. Red light was applied for 30 min. and 60 min. followed by far red light for 30 min., 60 min., and 90 min. Intervening dark periods between the red and far-red exposure is known to reduce the effectiveness of the far red light; a group of plants treated with 1 hr. red light was subjected to 1 hr. far red exposure after dark intervals of 15, 30 and 60 minutes. At the end of each treatment the plants or leaves were extracted in hot 80% ethanol. The aliquots of the concentrated clear extract were subjected to paperchromatography and autoradiography for separation and detection of the metabolites.

Darkness, red or far red light affected the rate of decarboxylation and hydrolytic reactions differently depending on the photoperiodic behaviour of the plant. The immediate effect of red light on the products of dark or photosynthetic  $\text{C}^{14}\text{O}_2$  fixation was considerable decarboxylation. Of particular interest among the individual compounds were the phosphate esters and malic acid. In the dark-fixation of  $\text{C}^{14}\text{O}_2$  in the long day barley bulk of the label appeared in phosphate esters, very little appeared in malate. In photosynthetic  $\text{C}^{14}\text{O}_2$  fixation considerable acti-

vity was detected in malate. Label in malate completely disappeared by a 30 min. exposure to red light. In short day Cocklebur opposite was the case i.e., radio-activity in malate increased with exposure to red light. When the far red light followed the exposure to red, in barley label appeared in malate, whereas it gradually disappeared in Cocklebur.

**149. Carbon dioxide fixation and auxin-induced growth of Avena Coleoptiles.**

S. P. SEN, Calcutta.

Presence of  $\text{CO}_2$  in the experimental atmosphere has been shown to promote the auxin-induced growth of Avena coleoptiles. In order to study the metabolism of growing Avena coleoptiles in relation to  $\text{CO}_2$  fixation 6 mm. subapical sections of Avena (var. NPI) coleoptiles were floated on a medium containing  $30\mu\text{C NaHC}^{14}\text{O}_3$ ;  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-7}$  M indoleacetic acid at pH 7.0 for 15 hours in darkness. The coleoptiles were extracted in hot 80% ethanol and chromatographed two-dimensionally on Whatman No. 1 filter paper with phenol-water and butanol-acetic acid-water as the developing solvents. The  $\text{CO}_2$  was fixed into such Krebs cycle acids as citric, malic, fumaric acids and a number of amino acids including aspartic and glutamic acids. In presence of indole acetic acid in all concentrations used, enormous amounts of tracer carbon was incorporated in malic acid.

The implications of the findings are discussed.

**150. On a remarkable morphological transformation of pollen grains in musically excited plants by violin.**

T. C. N. SINGH and (Miss) STELLA PONNIAH, Annamalaiagar.

Flowers of musically excited plants of Tobacco, Petunia and Chillies all belonging to the family Solanaceae, were examined. Hardly any difference was noticed in the size of the flowers but there was notable difference in the size of gynoecia and anthers namely: they were bigger in size as compared to those of the control.

The pollen grains of all the three species were critically examined and it is curious to note that those obtained from musically excited plants were elongate and ellipsoidal of the tricolpate type whereas those obtained from the control plants of all the three species were oval, tending to become circular. The exine in each case was smooth and size difference were however very much marked in tobacco and Petunia.

**151. Culture of excised embryos in relation to endosperm auxin and other growth factors.**

S. M. SIRCAR and A. N. LAHIRI, Calcutta.

Experiments for the culture of excised rice embryo in nutrient media have been carried out and the following results obtained.

Some factor, possibly auxin in nature, is present in the endosperm in supra-optimal concentration which exerts a retarding effect on embryo growth in initial stages of germination.

The shoot development unlike the root growth is not much effected with the fractioning of endosperm until it reaches a limiting value. The rice embryo is dependent on the endosperm food factors to a great extent for its growth and germination.

Besides other factors, sucrose and salts are essential for this. When they are present alone in the medium the growth is very limited. The vitamins play a very important role in the growth of rice embryo. Indolyl acetic acid in combination with vitamin B<sub>1</sub> and vitamin B<sub>6</sub> produces very healthy plants with normal root and shoot development.

**152. Vernalization and devernialization of summer and winter varieties.**

S. M. SIRCAR and ARATI ROY, Calcutta.

Seeds of winter and summer varieties of rice during germination were treated with different degrees of continuous and alternate ranges of temperatures for varying duration.

In winter variety high or low temperatures show retardation of flowering while acceleration was recorded at alternate exposures of high and low temperatures. Similar results were obtained with late sowing in winter. The effect of short day induction however did not intensify the vernalising reaction.

In summer variety an acceleration of flowering was noticed at subnormal temperature. The optimal degree for vernalization was 12°C the effect of which extended and gradually slowed down upto the level of 30-31°C the normal field temperature of the crop. Above normal temperature (i.e., at 37°C) a devernialization effect was found which increased with duration. Such retarding effect of high temperature was annuled under subsequent exposure to low temperature.

**153. Auxin content of embryo and endosperm of two varieties of rice at different soaking periods.**

S. M. SIRCAR and ARATI ROY, Calcutta.

The study of changes of auxin content in rice grains during the soaking period was made. Auxin content of embryo and endosperm of two varieties of rice Rupsail (winter variety) and Dharial (summer variety) was estimated after the grains were being soaked for 0, 8, 16, 24, 32, 48 hours. Auxin was extracted by water at low temperature and assayed by root inhibiting test as developed by Das and Gregory. Endosperm of summer variety of rice contained higher amount of auxin than that of winter variety, while no such appreciable difference in auxin content was noticed between the embryos of two varieties. With the increase of soaking period a significant reduction of auxin content was noticed in the endosperm but auxin of the embryos maintained more or less a constant level. The fate of the auxin released from the endosperm has not yet been studied.

**154. Auxin in relation to flowering.**

S. M. SIRCAR and MAYA KUNDU, Calcutta.

An experiment was performed with rice plant Var. Chinsura Boro I and Rupsail to study the effects of the application of different concentration of auxin on growth and flowering.

The method of application adopted was to add Indolyl acetic acid (IAA.) in nutrient solution in test tubes. The seedlings were grown successfully for 6 days in test tubes and subsequently transplanted in pots and growth of the 1,000 p.p.m. of IAA. treated plants were stunted and the leaves were dwarfish with thicker textures. In the 100 and 10 p.p.m. the leaves were normal but yellowish. In the 1, .1, .01 and .001 p.p.m. and the control leaves were quite normal and healthy.

This condition prevailed upto one month after which suddenly the plants in the 1,000 p.p.m. showed vigorous growth with normal development. It is interesting to note that the plants treated with 1,00 p.p.m. and .01 p.p.m. of IAA. showed an acceleration of ear emergence by 47 and 22 days respectively.

**155. Germination of Malvaceae Pollen : Okra (*Hibiscus esculentus* L.), Cotton (*Gossypium herbaceum* L.) and Tree Mallow (*Lavatera arborea* L.).**

GYANENDRA VERMA and BASANT LAL VERMA, Almora.

Among the *Malvaceae* only the germination of cotton pollen in artificial media has been reported (Badami, 1922; Shibuya, 1930; Johri and Vasil, 1955). We are not aware of any work on the germination of Okra and *Lavatera* pollen.

Experiments with the pollens of Okra 'Green Velvet', four strains of cotton (I.V., 216 F, Sea Island and Sea Brooke) and of tree mallow are reported. *Malvaceae* pollen are in general large, round, echinulate, and characterised with several germ pores giving rise to 1-6 pollen tubes. All the pollen tried could be germinated only in sucrose—1% agar media and not in liquid media (i.e. sucrose solution alone). All the pollen grains required comparatively high concentrations of sucrose in the media for maximum growth: Okra—22.5%; Cotton 32.5%; mallow 15-30%, but they germinated freely over a wide range of sucrose in the media; Okra 5-40%, Cotton 11-40% and Mallow 15-45%.

Okra pollen grains put out three to four fat and freely branching tubes. Individual tube lengths up to 2,280 microns and total length, including branches, of 2,850 microns were observed. In case of cotton, individual pollen tube growth of 520 microns, 340 microns, 400 microns and 400 microns was obtained respectively with the above four strains of cotton pollen, while the combined growth of tubes from a single grain was respectively 980 microns, 560 microns, 880 microns and 884 microns.

In case of *Lavatera* pollen the tube growth was found to be fairly uniform within the range of 15-30% sucrose in the media. Individual pollen tubes of upto 580 microns and combined growth of upto 1,240 microns was observed.

**(xii) Ecology and Plant Geography**

**156. Endemism and outside influence on the Flora of Manipur.**

D. B. DEB, Agartala (Tripura).

While writing on the Forests of Manipur, Watt, in 1890, observed, "The Sikkim type becomes established with the occurrence on the heights above the Irong, of *Aucuba himalaica*, a bush everywhere from the Laimatol range at 4,000 ft. to Seramati at 1,000 ft." With a view to examine this observation of Watt, the present paper is devoted to an analysis of the floristic composition of Manipur, a study of which was undertaken by the author during the years 1951-55. It was found that the state contains 2,191 species of higher plants ranging from Pteridophyta to Angiosperms, including 2 species new to science, 8 sp. new to India, more than 200 sp. new records for Assam region and about 1,500 sp. new records for Manipur.

The new species are (1) *Hoya manipurensis* Deb and (2) *Gleadovia banerjiana* Deb sp. nov. The former is already published.

Of the eight species found to occur in Manipur as new records for India, one (*Viscum ovalifolium* A. P. de Cand.) is already recorded by Seshagiri Rao, the others are named below with the original home mentioned in the parenthesis.



(1) *Arundinaria Kurzii* Gamble (South Burma); (2) *Bambusa Kingii* Gamble, (Upper Burma), (3). *Cycas siamensis* Miq.—(Siam), (4). *Craibiodendron Shanicum* W. W. Smith (Burma), (5). *Dichoptera riparia* Nees—(Burma), (6). *Leucomeris decora* Kurz—(Pegu) ; (7). *Helicteres Glabriuscula* wall—(Burma).

Of 2,191 species found in Manipur only 30 sp. i.e. 1.3% are endemic to this state, with few exceptions, most of the other species do occur in the Assam region.

There are about 30 species hitherto known to be endemic to Khasi Hill, which are recorded from Manipur.

There are about 24 species of restricted distribution to different districts of Assam which are found in Manipur also.

Seven species restricted to Khasi Hill and Naga Hills only are found in Manipur also.

Four species endemic to Mishmi Hills, and two species endemic to Cachar, are now recorded from Manipur.

With the discovery from Manipur endemism of Assam is reduced by 68 species and that of Sikkim Himalayas by only seven species.

In the light of the above findings the observation of Watt, may very easily be set aside and it may safely be inferred that the flora of Manipur has more similarity with that of Khasi Hills than that of Sikkim Himalayas.

Thus it is found that Manipur forms a phytogeographical part of Assam with a very high percentage of Indo-Malayan species and admixture of some Burmese, Siamese, Chinese and Sikkim Himalayan plants.

#### 157. A sketch of the vegetation of Tripura.

T. R. DUTTA and N. K. CHAKRABORTY, Agartala.

References on the vegetation of Tripura in (well known) works on Indian flora are scarce. An attempt has been made to study the vegetation of Tripura from a phytogeographical and ecological standpoint. The work in this respect commenced in January 1956. Topographical, geological, climatic and edaphic factors have been discussed in the paper. A classification of the forest ecotypes based on dominant formation has been attempted. It appears that the vegetation on the whole is of tropical monsoon type except a portion in southern sub-divisions which is of sub-tropical deciduous type. Forests are mainly of the following types: dense mixed forest, scrub jungle, high-grass land and bamboo forests of different ecotypes. Specimens collected so far reveal the following: Dicots—369, Monocots—88, Gymnosperms—10, Pteridophytes—28, Bryophytes—16, total number of species 511. There appears to be a *prima facie* case for finding new species of *Psidium*, *Begonia* and *Pothos*. The investigation is being continued.

#### 158. Studies in the Hydrophytes of Umred.

M. V. MIRASHI, Nagpur.

The paper deals with the floristic composition, distribution and ecological classification of the vascular hydrophytes of Umred, a place situated at a distance of twenty-nine miles to the south-east of Nagpur. The habitats of the water and marsh plants comprise about a dozen lakes situated on the outskirts of the city as well as temporary ponds and ditches. There is an average annual rainfall of about fifty inches.

Besides *Marattia*, *Azolla* and *Isoetes*, fifty species of Angiosperms have been reported. They include sixteen families and thirty genera of the Dicotyledons and eleven families and eighteen genera of the Monocotyledons. Both primitive

families, e.g., Nymphaeaceae, Butomaceae, Alismaceae, as well as advanced and specialized ones like the Compositae, Verbenaceae, Gramineae, figure in the flora.

The paper contains a discussion of the ecological factors of the various habitats as well as the range of distribution of the hydrophytic species. Four species, viz. *Trapa bispinosa*, which is largely cultivated in most of the lakes. *Eclipta alba*, *Asteracantha longifolia* and *Hydrilla verticillata* have the widest distribution while sixteen species, the chief among them being *Isoetes*, sp., *Linnanthemum indicum* and *Butomopsis lanceolata* are restricted to one particular locality.

#### 159. Velamen in roots of certain Liliaceae.

B. N. MULAY, B. D. DESHPANDI and P. N. Bharadwaj, Pilani.

1. Velamen is observed in the roots of four species of Liliaceae viz. *Scilla indica* Bak. *Dracaena surculosa* Lindl; *Urginea indica* Kunth; and *Lilium longifolium* Griff.

2. In all the species it is one layered. In *Dracaena surculosa* and *Lilium longifolium* pits are observed, other two species show no significant specialisation.

3. Velamen is developed from the protoderm in all the plants studied.

4. A well developed exodermis is found in all the species. This layer takes its origin from the periblematic initials in all the species except in *Dracaena surculosa*.

5. Structure and development of velamen and exodermis found in these plants is compared with velamen of other plants.

#### 160. Study of Velamen in some epiphytic and terrestrial orchids.

B. N. MULAY, B. D. DESHPANDI and Miss H. B. WILLIAMS, Pilani.

1. The different concepts of velamen are reviewed.

2. The present work deals with the study of the origin, development and structure of velamen in three epiphytic and one terrestrial species of Orchidaceae.

3. The ontogeny of exodermis and its morphological identity are investigated.

4. A comparison between the structure of exodermis and endodermis have been made.

5. The presence of pitted cells in the cortical region has been noted. The presence of mycorrhiza in velamen and provision for its digestion in some specialised layers of the cortex have been studied.

6. The presence of various algae, specially Cyanophyceae has been observed in the velamen of *Eria nana* A. Rich. A significant feature is the presence of *Nostoc* colonies in large numbers.

#### 161. Study of Velamen in *Microstylis densiflora* Alston; *Cymbidium aloifolium* SW; *Grammatophyllum speciosum* Bl; and *Aerides ringens* Fischer.

B. N. MULAY, B. D. DESHPANDE and T. A. THOMAS, Pilani.

1. The paper deals with the origin, development and structure of velamen in *Microstylis densiflora*, a terrestrial species and *Cymbidium aloifolium*, *Grammatophyllum speciosum* and *Aerides ringens*, the three epiphytic species.

2. The ontogeny of velamen and its morphological identity has been studied.

3. The origin of exodermis and its structure has been studied.

4. Water storage cells with characteristic thickenings have been found in the cortex of all the three epiphytic species.

5. Unicellular algae are present in velamen.

6. Mycorrhizae are observed in velamen and are seen being digested in the cortex.

**162. Trends of secondary succession in the forest vegetation on Basalt Hills in Jabalpur.**

S. C. PANDEYA, N. K. JAIN and S. R. JOSHI, Jabalpur.

Much of the forests around Jabalpur are the products of biotic operations. Upon protection these forests tend to develop into climatic climax. The present paper deals with the sequence of changes of vegetation in such a fenced community. These protected forests are seated inside the local Central Ordinance Depot Campus. The forest is on basalt hills-range facing west. Other portions of the same range are still open to biotic activities. The C.O.D. forest was fenced in 1940 and has not been disturbed since then. This has given opportunity to study the open and fenced forests and to draw the conclusions for the trends of secondary succession.

A close study of the relative importance of the species in the two forest types show that certain species are fast increasing in Cover X Frequency, while others are decreasing when under late subseral stage upon protection. Thus *Anogeissus latifolia*, *Semicarpus anacardium* and *Terminalia tomentosa* are occupying larger areas and *Butea menispermica*, *Carissa spinarum* and *Diospyros melanoxylon* are decreasing. Further in case of late subseral stage (fenced C.O.D. forest) many new species like *Buchanania latifolia*, *Phyllanthus emblica*, *Bridelia relusa*, etc., have invaded the area.

The following conclusions may be drawn for the trends of secondary succession towards climatic climax :—

- (i) Certain species decrease and certain others increase in their relative importance in late subseral stage.
- (ii) certain species are completely eliminated.
- (iii) Some new species are introduced in the climax community starting from the late subseral stage.

**163. Notes on the Autecology of *Shorea Robusta* Gaertn (Sal).**

S. C. PANDEYA and N. K. JAIN, Jabalpur

Lot of fragmentary work has been done by the forest Department in India on the ecology of Sal tree. Such works have been attempted with varied interests and view points. No connected work yet exists on this problem based on sound fundamental laws of ecology. For the first time, therefore, we have undertaken this work.

In Madhya Pradesh sal is confined to eastern and north eastern parts of the state. It is chiefly distributed in Bilaspur, Mandla, Jabalpur, Balaghat, Raipur, Ambikapur and Jagdalpur districts (cf. fig. 1.). Finest quality sal is found in the Bastar districts (Southern limits).

Sal shows the following associates in Mandla district :—*Terminalia tomentosa*, *Oueginia dalbergioides*, *Pterocarpus marsupium*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Adina cardifolia*, *Stereospermum suaveolens* and *Buchanania latifolia*.

Soil moisture plays a primary role in the distribution of sal while the local geology plays a secondary part (cf. Troupe, 1921). Good drainage of soil is taken as an important factor. No clearcut correlation has yet been established between sal distribution and geology. A comparison between sal distribution, geology and rainfall maps of Madhya Pradesh reveals that sal is mainly confined to zones having 50 to 75" of rains and on crystalline rocks (Archean system) and appears to avoid pure trap. Apart from this, somewhat acidic soils have been correlated with sal.

Further detailed work on the basis of culture experiments is in progress.

**164. Vegetation of certain sandy river-beds.**

H. PATTNAIK and C. M. BASTIA, Cuttack.

A number of plants growing on sandy river-beds of the Mahanadi and its branch the Kathjuri, surrounding Cuttack city, has been collected at regular intervals. The plants have been studied with particular reference to their habitats. It has been observed that the members of families of Scrophulariaceae and Compositae are dominating. The plants are mostly mesophytes, xerophytes and psammophytes. Few hydrophytes only grow in slow flowing water.

Majority of plants are either annual or seasonal herbs. Perennial plants are few and occur as herbs or shrubs. There is total absence of trees due to yearly floods. *Vitex leucoxydon* L.f. is the only tree found singly on sand dunes.

**165. The vegetation of Mussoorie and the neighbouring parts of the Siwaliks.**

G. S. PURI, Poona.

Mussoorie is an important Hill Station in the outer ranges of the Himalayas and is found mainly of the escarpment of Quartzite, Limestone, Schists and Slaty Rocks.

In the Siwaliks, the rocks are Conglomerate and sand rock. The climate of Mussoorie is typically monsoonic. It receives rainfall of 88 inches a year. : There have been no signs of glaciation in this area.

The vegetation on Quartzite is dominated by *Pinus roxburghii*. The climax on this formation is, however, *Quercus incana*. There is very little variety of shrubs and undergrowth in *Quercus incana*, climax on Quartzites. On lime-stone, however, the *Quercus incana* climax has a variety of species, among which *Machilus* spp., *Litsea* spp., *Phoebe* spp., *Prunus* spp., Poplar etc. are present. On drier situations on the lime-stone formations, however, the *Quercus incana* community is almost pure.

The proportion of species other than the Oaks increases considerably in dales and depressions. There is a preponderance of species of ferns, liverworts, mosses and lichens.

On the Siwaliks the main species is *Shorea robusta*, *Terminalia tomentosa*, and *Anogeissus latifolia*, and *Bauhinia* spp., are other common trees in the Sal community. This community is climatic climax in its altitudinal zone. Due to disturbance *Pinus roxburghii* also enters this community.

Deodar has been planted at many places on calcareous tuffa above an altitude of 6,000 feet at Mussoorie.

In this paper, a detailed list of plants so far collected is given. The list includes 1,031 species of dicotyledons, 184 species of grasses and 146 species of ferns and fern allies.

**166. Scrub vegetation of Poona District.**

G. S. PURI and S. K. JAIN, Poona.

Intense and continuous biotic interference in the Poona District has destroyed much of the tree vegetation replacing it with scrubby growth. One patch of open scrub was studied at Garkau the forest, Dhond, 50 miles east of Poona.

The soil is formed of weathered traprock and being within the flood level of river Bhima, the area on the surface has sands also. The vegetation was studied in quadrats of one meter square at random. The total number of species collected in the area in September are about seventy-five including a dozen grasses. The general look of the area is not of grass land.

Species of *Abutilon*, *Capparis*, *Triumpelta*, and planted *Acacia* are the tallest plants in the area reaching upto one meter high. Their frequency is not high and they are rarely nearer than several meters apart.

The commonest herbs are prostrate, nearly covering the ground. They are *Rhynchosia*, *minima*, *Tribulus terrestris*, and *Euphorbia* sp. Among the commonest erect herbs are species of *Justicia*, *Panicum*, *Corchorus*, *Cyanotis* and *Acalypha*.

The area has been closed to grazing and planting of *Acacia* has been taken up by the Forest Department. The progress of vegetational development will be seen with interest.

#### 167. Studies on the vegetation of Mahabaleshwar.

G. S. PURI and S. D. MAHAJAN, Poona.

Mahabaleshwar Plateau lies in the Western Ghats, 76 miles from Poona on South West. The altitude of the plateau is 4300' to 4800'. The rainfall of Mahabaleshwar is from 250" to 300". The plateau is formed of Deccan Trap and on account of high rainfall conditions lateritic soils are found in most of the places.

The vegetation of Mahabaleshwar is an evergreen forest consisting of following species :—

*Memecylon edule*, Roxb., *Olca dioica* Roxb., *Eugenia jambolana*, Lam., *Terminalia chelula*, Retz., *Actinodaphne hookeri*, Meissn and *Randia dumetorum*, Lank.

The shrub layer has the following important species :—

*Lasiosiphon eriocephalus*, *Zigypus rugosa*, *Pavetta indica*, Linn, *Allophylus cobbe*, Bl., *Colebrookea oppositifolia*, Sm.

The herbaceous layer consists mainly: *Pteris quadriaurita* Retz., *Pteris aquilina* L., *Crotalaria retusa* Linn and *Bryophyllum Calcinum* Salisb.

The trees are mainly 15-20 meters high, with their trunks and branches being covered over with mosses, orchids and epiphytic ferns.

Vegetation studies were made from the Lingmala fall, Arther's seat road, Mahad road and Pauchagani and the main part of the plateau.

Where the tree vegetation has been destroyed a scrub forest consisting of the following species occurs :—

*Pteris quadriaurita* Retz., *Pteris sunilina* L., *Crotalaria retusa* Linn., *Solacum giganteum*, Jacq., *Pavetta indica*, Linn, *Agoratum connizoides*, Linn., *Asplenium falcatum*, Lam.

This vegetation is a biotic controlled seral community and the evergreen forest is the climax.

#### 168. The study of soil profiles under Oaks and Conifers of Chakrata Himalayas.

G. S. PURI and J. S. MAINI, Poona.

Soil profile studies made under pure Oak and Conifer communities in Chakrata Himalayas, U.P., (77°-45'—78°-5': 30°-30'—30°-59') show that under similar climatic condition different types of soils develop under different communities.

Under Conifer communities, generally soils have low pH, total nitrogen %, Mg, replaceable Ca, active Al, and ferric iron, but have a high amount of organic matter (loss on ignition) %, moisture %, Mn, P, and available K, as compared to those under Oaks.

Soils of Chakrata Himalayas can be divided as follows according to pH and altitude, and the plant communities they support.

1. Soils from altitudes of 4,500' to 6,000', support *Pinus roxburghii* community with pH 5.3—5.8. These are rocky, dry and shallow soils with very low organic

matter %, moisture %, total nitrogen %, active Al, and ferric iron, and medium to high relative humidity, replaceable Ca, and Mg, and very high Mn, P, and available K, as compared to all other soils.

2. Soils from an altitude of 6,000' to 7,500' under *Pinus excelsa* and *Quercus incana* community, have a pH between 4.5—5.3. Those soils are shallow to fairly deep and are fairly moist. Those under *Pinus excelsa* as compared to those under *Quercus incana*, have lower organic matter %, total nitrogen %, Mg, replaceable Ca, active Al, and ferric iron; and higher moisture %, relative humidity, Mn, P, and available K.

3. Soils from altitudes of 7,500'—9,000', under *Cedrus deodara*, *Picea morinda* and *Quercus dilatata* communities have pH between 5.9—6.6. These soils are from shallow to very deep, rich and moist. Soils under Conifers as compared to Oaks are low in pH, total nitrogen %, and Mg; and high in organic matter %, moisture %, relative humidity, Mn, P, available K, active Al, ferric iron, and replaceable Ca (both the Conifer communities were on lime-stone and that of Oaks on quartzite).

4. Soils from altitude of 8,500' to 9,500', under *Quercus semecarpifolia* and *Abies pindrow* communities have pH between 5.4—5.7. Soils under the latter have comparatively low total nitrogen %, Mg, available K, replaceable Ca, active Al, and ferric iron; and higher pH, organic matter %, moisture %, relative humidity and Mn.

There soils are generally non-calcareous.

#### 169. Succession of forest communities in Chakrata Himalayas.

G. S. PURI and J. S. MAINI, Poona.

Chakrata Himalayas, U. P., ( $77^{\circ} 45' - 78^{\circ} 5' : 30^{\circ} 30' - 30^{\circ} 59'$ ) are the unglaciated parts of mountains which are composed of quartzite, schist and limestone. The strata of the rocks dip mainly towards north and north-east, forming escarpments on southern slopes and dip slopes towards the north.

Climatically, most of the area comes in the high rainfall zone, however, in the inner parts summer rainfall is equalled by winter rain and snow.

Much of the forests in the area have been disturbed by the biotic interference, as a result of which climax communities have partly been destroyed giving rise to mixed conifer-oak communities.

The climax community on shales and schists in both the zones of rainfall is *Quercus incana* with *Rhododendron arboreum* as its important associate.

Except for few trees, *Pinus roxburghii* is absent in outer ranges, but forms a stable edaphic climax on quartzite in the inner ranges.

In the wet zone, on limestone, *Quercus incana* and *Quercus dilatata* communities are found.

*Abies pindrow*, *Abies pindrow*—*Picea morinda* and *Picea morinda* communities occur on limestone and slates in the wet zone, on dip slopes.

*Cedrus deodara* and *Pinus excelsa* occur in both zones on all types of geological strata, aspects and slopes, and are seral in nature.

*Quercus semecarpifolia* is the climax community on scarp slopes, capping the tops of highest ridges in the wet zone and is found on slates, limestone and schists.

The present studies lead to the conclusion that one or the other species of oak is the climax vegetation and that conifers are seral in nature.

Degenerate *Quercus semecarpifolia* climax communities give rise to *Abies pindrow* and/or *Abies-Picea* communities. Similarly *Quercus dilatata* communities under biotic influence degenerate to *Abies-Picea* communities and *Quercus incana* climax communities give rise to *Pinus excelsa* and *Cedrus deodara* communities under adverse biotic interference.

Human factor has been responsible for destruction of oak climax and perpetuation of conifers, and further in the creation of scrub communities without tree growth and pasture lands.

#### 170. Moist deciduous vegetation of the Poona District.

G. S. PURI and R. M. PATIL, Poona.

Moist deciduous vegetation grows in various ghats and hills in the Poona district. The present note describes the type from the Katraj ghats, on the south of Poona at a distance of 6 miles.

The area consists of flat plateau at the top, eastern and western slopes and narrow valleys through which small rivulets flow during monsoons. The mountains are forms of trap rock, the strata of which dip somewhat towards east. Thus the eastern slopes are gentle with better developed soil but the western escarpments are steep, comparatively dry and with shallow soil. Seepage water is seen on eastern slope during monsoon. Alluvial soil deposits in the valley. The average rainfall is about 27 inches.

The following vegetation types are described.

(i) *Top of the Plateau* :—They are mainly covered with *Boswellia serrata* which is regenerating profusely where biotic interference is excluded and the soil is dry shallow and gravelly.

(ii) *The western slopes* :—These slopes bear a low type of forest. The following trees are common.

*Boswellia serrata*, *Lanea grandis*, *Diospyros montana*, and *Lagerstroemia parviflora*. Shrubs :—*Acacia* sp., *Lantana camara*, *Zizyphus xylopyrus*, *Rhus mysorensis*, *Flacourtia*, *Citradessa fruticosa*, *Gymnospora montana* and *Fluggia* sp.

Herbs :—*Tridax procumbens*, *Leucas* sp., *Cocculus* sp., *Polyzygous tuberosus*, *Sida* sp., *Arisaema* sp., *Desmodium* sp., *Acanthospermum hispidum*, *Celosia* sp., etc.

This vegetation is also affected adversely by the biotic interference, since lopping, coppicing and grazing are prevalent.

(iii) *Eastern slope (top portion)* :—It bears a community of *Boswellia serrata*-*Diospyros montana*-*Lanea grandis* on dry shallow and rocky soil. The commonest shrubs are *Acacia* sp., *Zizyphus xylopyrus*, *Lantana camara*, *Cryptolepis buchnani*, *Woodfordia fruticosa*, *Vitis pallida*, and *Fluggia* sp.

The common herbaceous vegetation consists of *Cocculus* sp., *Leucas* sp., *Tridax procumbens*, *Curculigo* sp., *Polyzygous tuberosus* etc.

(iv) *Eastern slope (lower portion)* :—It bears a community of *Tectona grandis*-*Lanea grandis*-*Diospyros*-*Boswellia serrata*.

*Teak* and *Lanea grandis* are predominant on the alluvial deposits towards the valley and higher up. *Diospyros* sp., and *Boswellia* become prominent in dry trap soil. *Diospyros* on alluvial soils is heavily infected by *Viscum*. But incidence of the parasite decreases in trees which are growing on dry trap rocks elsewhere in the area.

Commonest Shrubs in the community are *Acacia* sp., *Clerodendron serratum*, *Zizyphus xylopyrus*, *Vitis pallida* and *Lantana Camara*.

Commonest herbs are *Leucas* sp., *Tridax procumbens*, *Hemidesmus indicum*, *Curcuma montana*, *Cocculus* sp., *Polyzygous tuberosus*, *Trichodesma* sp., *Crotalaria* sp., *Indigofera* sp., *Celosia* sp., *Aerua tomentosa* etc.

Various stages of succession are seen in the area and regeneration of *Teak*, *Boswellia*, *Lagerstroemia*, *Lanea* is common on different types of soils.

## 171. The Evergreen Vegetation of Poona District,

G. S. PURI and J. A. VASAVADA, Poona.

The evergreen vegetation occurs in a small belt at Bhimashankar, Ambegaon and Junnar area on the North-west of Poona, where the rainfall is above 150" and the soil is mainly red formed of lateritic rock. The area is hilly and cut up into shallow valleys and ghats. Two main types may be distinguished:—

**Forest**—This is composed of the following common tree spp. *Grewia tiliaefolia*, Vahl.; *Memecylon edule*, Roxb.; *Terminalia belerica*, Roxb.; *Terminalia chebula*, Retz.; *Mangifera indica*, Linn.; *Eugenia mooulana*, Wgt.; *Eugenia rubicunda*, Wgt.; *Ficus glomerata*, Roxb.; *Cassia fistula*, Linn.; *Ficus retusa*, Linn. etc.

The climbers and shrubs in these forests include the following spp.

*Bryonopsis laciniata*, Naud.; *Cryptolepis buehanani*, Roem.; spp. of *Smilax*, Linn.; *Vitis*, Linn., and *Dioscorea*, Linn.; *Hoya wightii*, Hook. and *Thunbergia fragrans*, Retz.

*Asparagus racemosus*, Willd.; *Indigofera pulchella*, Roxb.; *Lencaena glauca*, Benth.; *Mussaenda frondosa*, Linn.; *Woodfordia fruticosa* Kurz.; *Lantana camara*, Linn.; *Carula callosa*, Brem.

The herbaceous vegetation consists of the following *Arisaema murrayi*, Hook.; *Curcuma montana*, Rosc.; *Curculigo orchoides*, Gaertn.; *Clerodendron serratum*, Spreng.; *Oxalis corniculata*, Linn.; *Scilla indica*, Baker.; *Smithia purpurea*, Hook.; Spp. of *Hemerocallis*, Willd., *Impatiens*, Linn. etc.

The epiphytes and ferns are *Aerides crispum*, Lindl.; *A. maculosum*, Lindl.; *Dendrobium aequum*, Lindl.; *D. barbatulum*, Lindl.; *D. herbaceum*, Lindl.; *Erja dazellii*, Lindl.; *E. microchilos*, Lindl.; *E. rupestris*, Blatt. and Mac.

*Actinopteris dichotoma*, Bedd.; *Adiantum caudatum*, Linn.; *Anthyrium fulcatum*, Bedd.; *Cheilanthes albomarginata*, Clerke.; *Gymnopteris variabilis*, Bedd.; *Pleopeltis lanceolata*, Bedd.; *P. linearis*, Bedd.

This evergreen forest seems to be the climatic climax over much of the area.

(ii) **Scrub**—The scrub is developed mainly in the plain area and at places greatly disturbed by biotic influence. The main spp. are the following amongst the trees.—*Grewia tiliaefolia*, Vahl.; *Cassia fistula*, Linn.; *Pavetta indica*, Linn.; *Allophylus cobbe*, Blume, etc.

The climbers and shrubs are—*Carissa confesta*, Wight.; *Cannavallis ensoformis*, DC.; *Jasminum arborescens*, Roxb.; *Hemidesmus indicus*, R. Br. etc.

The herbs are *Arisaema murrayi*, Hook. Spp. of *Impatiens*, Linn.; *Indigofera trifoliata*, Linn. etc.

The vegetation forms thick, impenetrable masses entwined by climbers. The herbs occur in gaps.

This seems to be a biotic community and is seral in nature.

In both these types, trees are laden with epiphytic mosses, ferns, orchids and other flowering plants.

## 172. Vegetation of Evergreen Plantation at Hivre.

G. S. PURI and J. A. VASAVADA, Poona.

An enthusiastic missionary Gibson planted in the year 1883 a number of trees on alluvial soils of the river *Kukadi* at Hivre near Junnar about 60 on North-east of Poona. During these 70 years the plantation though neglected, forms a feature in the otherwise denuded landscape of Junnar. It is now maintained by the Bombay Forest Department as a preservation plot, its botanical interest being that its study exhibits the type of vegetation that can exist in the Junnar area.

Most of the trees have grown to large dimensions and are now regenerating naturally forming at places a thick natural type, of forest.



" The commonest tree Spp. are *Adenanthera pavonina*, Linn.; *Albizia lebbek*, Benth.; *A. procera*, Benth.; *Bauhinia purpurea*, Linn.; *B. racemosa*, Lam.; *Caesalpinia sepiaria*, Roxb.; *Cordia myxa* Linn.; *C. rothii*, Roem.; *Elaeocarpus ganitrus*, Roxb.; *Grewia villosa*, Willd.; *N. Holoptelia integrifolia*, Planch.; *Madhuca indica*, Gmel.; *Millingtonia hortensis*, Linn.; *Putranjiva roxburghii*, Wall.; *Sapindus laurifolia*, Vahl.; *Saraca indica*, Linn.; *Sesbania aculeata*, Pers.; *Tamarindus indica*, Linn.; *Terminalia belerica*, Roxb.; *Ventilago madraspatana*, Gaertn.

The shrubs and herbs are the following—*Abrus precariolus*, Linn.; *Agave cantala*, Roxb.; *Bambusa arundinacea*, Willd.; *Barleria cristata*, Linn.; *B. prionitis*, Linn.; *Carissa congesta*, Wight.; *Dodonaea viscosa*, Linn.; *Euphorbia antiquorum*, Linn.; *Indigofera constricta* Trim.; *Opuntia dillenii*, Haw.

*Abutilon indicum*, G. Dom.; *Bidens xiphioides*, Linn.; *Indigofera trifoliata*, Linn.; *Rungia repens*, Nees.; *Solanum xanthocarpum*, S. and W.; *Themeda cymbaria*, Hack., and other few grasses.

This forest is a biotic relict which gives data of immense value in the colonisation and succession of vegetation in the area.

### 173. Plant communities of Sagar Lake.

M. P. SHRIVASTAVA, Sagar.

Ecological studies of the vegetation were conducted on Sagar lake with respect to the distribution of various plant communities.

The condition for the development of macroscopic flora in the lake may be classified as physical, chemical and biotic. Physical factors include the amplitude of water levels, turbidity and depth and temperature of water. Chemical factors involve the nature of the substrata. Of the biotic agencies man is the paramount.

Accordingly, the following communities of aquatic and sub-aquatic plants have been established and their relations have been traced out:—1. Free floating communities; 2. Communities of rooted plants entirely submerged; 3. Communities of rooted plants with floating leaves; 4. Amphibious plants; and 5. Marsh plants.

### 174. Hydrophytes of Sagar Lake.

M. P. SHRIVASTAVA, Sagar.

Physiography of Sagar has been briefly described. Ecological study of the hydrophytes of Sagar Lake has been made and a list of 44 plants giving information in regard to the taxonomic position, habit, habitat and flowering time of each species is presented.

### 175. Forest types of the lower reaches of Punch-Chuli in the Mandakini Valley in Eastern Kumaun.

S. SINHA and K. C. BASU CHAUDHARY, Agra.

During October-November 1955 a botanical expedition was organised to study the forest types met with in the lower reaches of Punch-Chuli, a well known group of snow peaks in East Kumaun. The area of the study lay through the Mandakini Valley and along the Balati Glacier. Six types of forest formations distributed on a range of elevation of 10,000 to 13,000 ft., were noticed within 10 miles of the last tree line south of the snow peaks in the following ascending order:— (i) Yew—Hard Woods Formation, (ii) Hard Woods Formation, (iii) Fir—Rhododendron Formation, (iv) Birch—Fir Formation, (v) Pure Fir Formation and (vi) Birch—Rhododendron Formation.

## (xiii) Economic Botany

## 176. A preliminary report on red Squill grown in India.

S. N. BAL, B. GUPTA and B. K. MOZA, Calcutta.

Red squill (*Urginea maritima* (L) Baker) is a Lilaceous plant of Mediterranean coast. This exotic plant was successfully grown in Calcutta but the plants did not flower, excepting one, in more than four years time. Multiplication was done by cutting radial segments of the bulb with a portion of stem and scales.

The dissected bulbs are prone to attack by the "damping off" disease which can be controlled by the application of 1.5% sulphuric acid.

The fresh bulbs were extracted by the enzyme inhibiting technique and the dry extract, positive to the Liebermann reaction, was tested for the raticidal property. It was found that the bulbs of the plant in flower were more effective than the bulbs from the plants which did not flower.

177. Control of weed, *Acanthospermum hispidum*

D. BAP REDDY, Hyderabad.

Trials with different weedicides were made against *Acanthospermum hispidum* at Himayetsagar on a fallow land. The treatments given were Fernoxone ( $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1 and 2 ozs. per gallon), Atlacide  $\frac{1}{4}$  and  $\frac{1}{2}$  oz. per gallon, Extar 'A' ( $\frac{1}{4}$  and  $\frac{1}{2}$  oz. per gallon) and Coronox (45 and 90 c.c. per gallon) and a control without any treatment. The treatment was done on grown up plants. Observations on the effect of these treatments on the weed were taken 1, 3 and 10 days after treatment.

Except Atlacide  $\frac{1}{2}$  oz., the other chemicals had no effect on the weed immediately. Fernoxone 2 oz. Extar 'A'  $\frac{1}{2}$  oz. Coronox 90 c.c. had slight effect. The effect 3 days after treatment was good in case of Atlacide and Extar 'A'. Fernoxone and coronox had a good effect on the weed but their action was very slow. In Atlacide treated plots weeds completely dried up. Fernoxone  $\frac{1}{4}$  oz. and Extar 'A'  $\frac{1}{4}$  oz. had no effect on the weed. Repetition of spraying as not necessary as the weeds could be killed with one spraying only. Atlacide cannot be used on crops and Extar 'A' should be used carefully.

## 178. Cultivation of Emetine Yielding Plant in India.

K. BISWAS, Calcutta.

Introduction, acclimatisation and cultivation of exotic plants of medicinal and economic value dates from the establishment of the then Royal now Indian Botanic Garden, Calcutta, that is, from the time of Robert Kyd and William Roxburgh--the first Superintendent of the Royal now Indian Botanic Garden, Calcutta, in 1787. The two most valuable medicinal plants grown in India are Quinine yielding Cinchona and Emetine yielding Ipecacuanha. Cultivation of both these drugs brought India to the fore-front with the other drug producing countries of the world. Ipecac was introduced about 90 years' ago and during the last nine decades more or less experimental cultivation was going on in India. Steps have been taken by the State Government for its further extension and production of larger quantity of the roots to meet at least the country's demand. A brief account of the plant, its history, introduction, acclimatisation, methods of cultivation, chemical and medicinal properties and its future position in the world market have been discussed in the paper.

179. Studies in the essential oil-yielding plants of India. I—Cultivation of *Ocimum kilimandscharicum* Guerke in West Bengal for production of natural camphor.

J. K. CHOUDHURY, Calcutta.

Experimental plantings of *Ocimum kilimandscharicum* Guerke were undertaken in the different regions of West Bengal to explore its possibilities as a source of natural camphor and it was found that Sukna (Dist. Darjeeling—alt. 500 ft.) was very suitable for the purpose.

The total yield of essential oil from air-dry leaves of plants at Sukna varied between 4.00% and 5.457% of which 65.97% to 80.50% was camphor. Similar estimation with plants raised at Mahatpur (Dist. Nadia) gave an yield of 2.56% to 3.17% with 61.66% of the same as camphor. The physical and chemical properties of the distillates were also determined.

Calculated yields of volatile oil from small plots at Sukna and Mahatpur, respectively, were 82 lbs. and 42 lbs. per acre per year with about 60% to nearly 80% of the same as camphor.

The leaves of a plant gave out most of its essential oil as the majority of the superficial oil glands were found, by anatomical investigation, to be present on the two surfaces of its leaves. Gland head of a leaf, on an average, also found to be bigger in size than that of a twig.

A full botanical description of the plant is included for convenience in comparison and proper identification.

180. Studies in the essential oil-yielding plants of India. II—A few observations on the Camphor and Camphor Oil of *Cinnamomum camphora* T. Nees & Eberm. found in West Bengal.

J. K. CHOUDHURY, Calcutta.

In order to determine the camphor and camphor oil contents of *Cinnamomum camphora* T. Nees & Eberm. that are sporadically met with in West Bengal, leaf and wood of the trees growing at Sibpur (Calcutta) and Takadah (Darjeeling district) were analysed and the physical and chemical properties of the distillates were also determined. It was found that the yield of oil (by weight of the moisture-free material) from the trees at Sibpur was 1.236% from leaf and 4.884% to 5.224% from wood, of which 50.09% to 57.57% was camphor. Those growing at Takadah gave a higher yield of 2.859% from their leaves of which 80% was camphor. As the yield of camphor from these leaves was more than 1.6% of the dry material, excluding even the dissolved fraction (of which a large part is recoverable), it promises to be economic since it is estimated in Japan that leaves containing about one per cent of camphor can be utilised with profit for distillation (c.f. Guenther's Essential Oils, Vol. 4, p. 281, 294, 1950).

*C. camphora* was also raised from seeds at Arabari (Dist. Midnapore) and Sukna (Dist. Darjeeling) during 1953-54 to study their germination and growth habits and to analyse their camphor content in due course.

181. A note on the percentages of fibre in some fibre crops.

A. N. DUTTA and P. SANYAL, Barrackpore.

*Hibiscus cannabinus*, *H. sabdariffa* (green), *H. sabdariffa* R. T. 2 (evolved at J.A.R.I.), *H. esculentus*, *Crotalaria juncea*, *Malachra capitata*, *Urena lobata*, *U. sinuata*, *Abutilon indicum*, *Sida rhombifolia* and *Sesbania aculeata* were grown in

small plots during 1951, 1952 and 1953 to determine their respective fibre percentages. Records on green weight, number of plants and fibre were taken in all the three years. Percentages of fibre for each were determined on the basis of green weight.

Highest fibre percentage was recorded in *Hibiscus sabdariffa* R. T. 2 (5.167%), an improved type of J.A.R.I. *Hibiscus cannabinus* and *H. sabdariffa* (green) followed next with 5.663 and 4.58 percents of fibre respectively. *Urena sinuata* and *U. lobata* differed widely with respect to their fibre percentages being 4.283 in the former and 2.95 percent in the later species. The average percentages of fibre recorded in *Crotalaria juncea*, *Abutilon indicum*, *Malachra capitata*, *Sesbania aculeata* were much lower and varied between 1.69 in *Sesbania aculeata* and 2.95 in *Urena lobata*.

*Hibiscus sabdariffa* R. T. 2., evolved at J.A.R.I., in addition to its greater plant height and base diameter also contains more fibre percentage over all other types.

In case of *Urena sinuata* fibre percentage is fairly high but high yield of fibre is not obtained due to its slow rate of growth, shorter plant height and base diameter of plants at harvest.

Detailed work in this line is being continued.

## 182. Pharmacognostic studies of Indian Viburnum.

B. GUPTA and S. N. BAL, Calcutta.

The root and stem bark of *Viburnum prunifolium*, *V. rufidulum* and *V. opulus* are used as uterine antispasmodic. These plants are not found in India. Among the Indian species of *Viburnum*, *V. foetidum* and *V. coriacium* were investigated, which showed promise to be substitutes of the foreign plants. The morphology and anatomy of the stem and root-barks were studied and a preliminary chemical analysis was made. Different fractions of the extracts were tested on the intestine and uterus *in situ* of guinea pig and rat, which showed that the oleo-resinous fractions have got no antispasmodic effect. The ethyl acetate and alcohol soluble fractions have got marked antispasmodic action on uterus which were showing violent spasms.

There are spurious barks in the market which were anatomically unlike the barks of the two Indian species studied and have got no antispasmodic effect.

## 183. Fibre yielding weeds of Bombay and its Suburbs. II--*Abutilon indicum*. Sweet.

B. S. NAVALKAR, Bombay and S. M. BETRABET, Bangalore.

While studying the physical and chemical properties of bast fibres, it was considered desirable to investigate fibre plants yielding other than jute and similar plants with a view to find out the species, available in Bombay and its suburbs, that could be used as substitute for jute, as an acute shortage of jute was felt after the Partition between India and Pakistan in 1947.

It was found from the observations and phytosociological study that innumerable hereto neglected plants, especially belonging to cohort Malvales, are growing in abundance on waste lands of Bombay and its suburbs during monsoon. *Malachra capitata*, Linn. was first of the series already described in the previous paper. The second plant in series, is *Abutilon indicum*, Sweet. Its habitat is entirely different from that of *Malachra capitata* Linn. The absence of nitrate positive plants, indicates poor nitrifying capacity of the soil. It is an annual shrub 5 to 6 feet in height, abounding chiefly in tropics. It is not cultivated, but grows wildly in abundance. Further this plant has high fibre content (14.13%). The fibres are superior in colour and lustre to jute, but are coarser to feel.

*Abutilon indicum* Sweet., also compares well with commercial jute. It has long ultimate cells (1.9 m.m.), higher L/D ratio (128) and lower fat and wax content (0.498%). The cellulose content is low (87.48%) and the lignin content is high (13.18%) together with high nitrogen content (0.214%). This plant is inferior in its intrinsic strength (1.655 Gms./Denier) as determined by Schopper's tester.

The fibre of *Abutilon indicum*, Sweet. may be given a trial along with *Malanchra capitata* Linn., as a jute substitute or at least can be mixed up with jute fibre in certain large proportions. As this plant grows luxuriantly on waste lands, its cultivation will not displace any food or commercial crop.

**184. Effects of Planting Sweet Potato (*Ipomoea batatas*, Poir.) Cuttings with Basal and Terminal Ends in Ridges.**

S. N. SRIVASTAVA and K. B. SINGH, Almora.

Several strains of sweet potato (*Ipomoea batatas*, Poir.) were sent from Vivekananda Laboratory in 1949 to different States. Some of these e.g. Ranger, B. 5931 and B. 4004 gave the highest yield in Bihar and Bombay. The general practice of growing sweet potato in India is from vine cuttings. The normal way of planting these cuttings is to put the basal ends down. But when several cuttings from a single vine are made, extra care and time are needed in marking the basal ends during planting.

The present work was undertaken to find out if any difference existed in yield of roots obtained from cuttings planted (i) with basal ends on the ridges and (ii) upside down i.e., with the terminal ends on the ridges.

Trials in paired plot design were conducted at two places using two varieties viz. B. 196 and B. 4004. In one trial all the cuttings established and the stand was very even. But in the other the available moisture in 2 blocks being inadequate caused some cuttings planted upside down to die. However, the yield data of both the trials showed that there was no significant difference (at 5% level) between root or vine yield from either of the two treatments.

The results of these experiments seem to indicate that if at the time of planting the cuttings, the available moisture in fields is adequate it does not matter whether the cuttings are planted in the normal way or upside down.

**(xiv) Palaeobotany**

**185. Comparison of the fruits from the Deccan Intertrappean Rocks of India with those of the London clay of England.**

S. D. CHITALEY, Nagpur.

Various fruits described so far from the Deccan Intertrappean rocks of India are compared with the London Clay Flora of England. It has been found that there is a perfect identity between the fruit *Nipa hindi* (Rode) Sahni and *Nipa Burtini* (Brougniart). But in spite of points of superficial similarity between various London Clay and Indian Deccan Intertrappean Species, no further case of absolute identity between the two floras can be claimed.

**186. On the pollen grains and pollination of *Sahnianthus Parijai* Shukla.**

J. N. DWIVEDI and RAMRESH KUMAR SHUKLA, Nagpur.

The discovery of the pollen grains of *Sahnianthus* was first made by Shukla in 1944 when he recorded both isolated pollen grains as well as those *in situ* inside

the anthers of *Sahnianthus*. Shukla had also recorded in these pollengrains the occurrence of some germ pores and a body resembling nucleus. Beyond this, probably nothing was known of these pollen grains. In the present paper is described an excellent specimen of *Sahnianthus* flower with pollen grains actually present on the stigma. The pollen grains occur in the form of a small mass lying on the stigmatic surface. Some of these slightly isolated show a clear round or oval shape. Most of these are bicelled and have a double wall, the exine and intine. In a few cases the nucleus is also seen. Some of the pollen grains show small pollen tubes coming out, which often being fairly narrow get mixed up with the stigmatic papillae. The occurrence of these pollen grains on the stigma, apart from being a fact having its own importance is also helpful in the reconstruction of the *Sahnianthus* plant.

**187. On a new species of *Pentoxylon* with four stem bundles.**

V. B. SHUKLA, Nagpur.

Sahni described the stem *Pentoxylon* as having "a ring of large vascular bundles, nearly always five in number, which were responsible for the generic name; sometimes there are six bundles." He further stated "variants on the regular five-bundle plan may represent a second species of *Pentoxylon*." The specimen described in the present paper was collected by the author several years back from the same locality i.e. Nipania (Rajmahal Hills) and its cross section revealed curiously enough the presence of only *four* bundles and not five. A critical examination showed not even a trace of the fifth bundle which might perhaps have remained undeveloped nor there was any room for it. Each bundle consists of primary and secondary wood and looks like a tangentially expanded unit. The protoxylem of each bundle is mesarch and each primary bundle has the usual zone of secondary wood developed in a very unequal manner. It is prominently thick towards the pith and the first ring seems fairly well developed all round the primary bundle. The four bundles approach towards the centre leaving a little crushed pith. The secondary wood is of a compact nature and resembles considerably the wood of the normal *Pentoxylon*. The zone of cortex is not well preserved but extends quite uniformly all round the periphery. It is provisionally proposed to place this form in a new species *P. tetraxylodes*.

**188. *Botryococcites Shuklai* sp. nov., a fossil alga from the Eocene beds of Mohgaonkalan.**

L. C. SINGHAI, Nagpur.

The alga described here was discovered as a petrification in a brownish well preserved chert from Mohgaonkalan in close association with *Sahnianthus* flower. The material comprises three algal colonies which are more or less spherical and are connected with each other by rigid prolongations of the mucous envelope. Each colony has spherical cell aggregates with radially grouped cells embedded within a tough mucous membrane. The cells in each aggregate are pentangular or obovate and are closely connected with each other. An individual cell consists of a single parietal or discoid chloroplast, probably a pyrenoid like body and a large number of fatty oilish globules. The multiplication of cells seems to have taken place by longitudinal division. The present specimen shows maximum resemblance with the palaeozoic alga *Pila* and the living type *Botryococcus* and being a new eocene form is assigned to the new species *B. Shuklai*.

## SECTION OF ZOOLOGY AND ENTOMOLOGY

*President* :—DR. M. B. LAL, D.Sc., F.A.Sc.

### *Abstracts*

#### (i) Protozoa

##### 1. Temperature tolerance in trophic forms of Amoebae.

BANSIDHAR HAJRA, Calcutta.

Experiments were conducted to test the reaction of living protoplasm of the trophic forms of amoebae under extreme temperature variance. In one set of experiment, when trophic forms of *Acanthamoeba* sp. were exposed to 10°C., the activity of the protoplasm remained unaffected and the amoebae continued to throw pseudopodia at random. Till 20 hours' exposure at this temperature, regular trophic forms are maintained and no cyst formation seems to take place. In the second set of experiments, effects of temperature gradient on the high side have been studied on the trophic forms. At 38°C, they offer some interesting reactions. Amoebae are capable of remaining in trophic form under this high temperature and observation made after 5 minutes, indicates that the pseudopodial throwing still continues. The treated amoebae after 25 minutes exposure show the appearance of large vacuoles in their cytoplasm and the pseudopodial movements take place rather rapidly. Amoebae thus treated overnight (19 hours) depict the slowing down of their pseudopodial movements under the influence of thermal shock.

At 49°C, the trophic forms react in rather different ways. Amoebae round up almost immediately at exposure and retract pseudopodial movements. Exposure for 5 minutes is sufficient to denature the protoplasm.

##### 2. Chromatographic analysis of the asexual and conjugation stages of a ciliate *Blepharisma undulans* (Stein).

B. R. SESHACHAR and P. B. PADMAVATHI, Bangalore.

The technique of the chromatographic analysis of acid hydrolysates of the asexual (vegetative) and sexual (conjugants) stages of *Blepharisma undulans* (Protozoa : Ciliata), was undertaken with the object of determining characteristic patterns at the biochemical level. Hydrolysis of peptides and proteins is effected by acid hydrolysis. The individual amino acids in this hydrolysate were analysed by using the circular paper chromatographic technique. Biochemical significance for the presence of some additional amino acids in the conjugating individuals is discussed.

##### 3. Morphology of a new species of *Blepharisma* (Protozoa : Ciliata).

B. R. SESHACHAR and P. B. PADMAVATHI, Bangalore.

A study has been made of the cytology of an undescribed species of *Blepharisma*. Size of this new species ranges from 250-800 $\mu$ . The peristomeal membranelle

extends to about half the length of the animal. The nuclear apparatus reveals some striking differences from *Blepharisma undulans*. The macronucleus is cylindrical, and not beaded or dumbbell shaped in the vegetative condition. The micronuclear number vary from 6-25. The behaviour of the nuclear apparatus during binary fission and conjugation is discussed.

## (ii) Parazon

### 4. Properties of Sponge Cells in isolation.

SIVATOSH MOOKERJEE and BANKUBEHARI GANGULY, Calcutta.

Small pieces of fresh water sponges are squeezed through the silken mesh which help a quick dissociation. The dissociated sponge cells are transferred to sterile hanging drop preparations and continued observation made. Many interesting cell behaviours are observed. Archaeocytes are very active large cells, with granulated cytoplasm and show vigorous throwing of blunt pseudopodia. The rate of pseudopodia formation in them is about 6-8 per minute. Amoebocytes are small cells with hyaline cytoplasm and have prominent nuclei. They are equally active as archaeocytes but the nature of pseudopodia in them is generally very extensive and long. Choanocytes generally appear in groups, occasionally they are found in isolated condition. The beating of their flagella continues in isolation which show either rotation or whipping. Pinacocytes are slightly larger cells than amoebocytes, with prominent nuclei. Their movements are cumbrous. There are contractile projections which are shot out from the surface area of cells. Scleroblasts are cells of various size and are generally immobile. They show almost no surface activity. Skeleton forming material in various stages of formation has been observed inside them. Sperm cells are round cells with long flagellum and show rapid movements. Ova are comparatively large cells with numerous intracellular granules. They show almost no surface activity.

### 5. Exposure of Sponge Cells to Trypsin solution.

BANKUBEHARI GANGULY, Calcutta.

Observations have been made on the effects of various concentrations of trypsin solution on isolated sponge cells. Within  $\frac{1}{2}$  hr. to 1 hr. cells seem to be incapacitated in 4% solution. They round up and eventually die. In 2% solution cells show slowing down of the surface activity. The rate of pseudopodial throwing in them becomes reduced and within 2 hours pseudopodia appear only in the form of tiny hyaline bulge from the surface. The granules of the cytoplasm appear to be localised at a certain point in the cytoplasm; vacuoles also appear in the cytoplasm. Continued exposure cytolises the cells which ultimately die.

## (iii) Cnidaria

### 6. Morphogenetic basis of bud-formation in Hydra.

SOMES SANYAL, Calcutta.

The formation of buds in hydra is interesting from the point of view of morphogenesis. The origin of a bud appears externally as a local swelling on the



body. Generally it appears at about the mid-level of the trunk and grows into an elongated tube into which subsequently the tentacles develop, mouth opening takes place and ultimately it detaches itself off the mother-hydra. Morphogenetically, the process of bud formation is initiated first by the differentiation of the hypostome. Interstitial cells accumulate round the hypostome area by migration and they increase further by mitoses. Endoderm cells also start dividing mitotically, thus causing a local thickening and hence the appearance of a protuberance. Meanwhile the interstitial cells differentiate to produce other cell types like cnidoblast and nerve cells. Tentacular rudiments appear round the hypostome, which are further pushed out by active participation of endodermal cells and they thus elongate. Endoderm cells in the growing bud assume their characteristic form in the hypostome and also in basal region.

The morphogenetical role of interstitial cells in the origin, growth and differentiation of bud has been discussed.

#### 7. Individuality of cell-types in Hydra.

SOMES SANYAL, and SIVATOSH MOOKERJEE, Calcutta.

Morphogenetics sets cells into various histogenetic patterns. The individuality of hydra is amazingly less intricate and more attractive to embryologists, because its body is composed of a few histologically specific cell-types, namely, cnidoblast cells, interstitial cells, musculo-epithelial cells, nerve cells and endoderm cells. A critical study has been undertaken to map out the disposition of the different cell-types along the bodywall. The histogenetic maps based on cell-counts of different cell-types at the various levels of the adult hydra depict an interesting picture. The interstitial cells do not occur in the tentacle and hypostome regions. From the sub-tentacular region, interstitial cells occur along the entire length of the individual until at the middle region where they occur in abundance. These cells gradually disappear with the approach of basal region. The musculo-epithelial cells occur more or less in equal proportions throughout the length of the hydra. The disposition of the cnidoblast cells are maximum at the tentacular region. The cnidoblast cells are in equal proportion to the musculo-epithelial cells, but they are absent at the basal-most region.

#### (iv) Helminthology

#### 8. On a new avian trematode of the genus *Brachylaemus* (Dujardin, 1843) Blanchard, 1847.

P. N. CHATTERJI, Cuttack.

This paper deals with the description of a new trematode species of the genus *Brachylaemus* (Dujardin, 1843) Blanchard, 1847. Several helminthologists have worked and added new species to the genus *Brachylaemus* but practically no work has so far been done in India. For the first time a new species of the genus has been recorded from India. Only two specimens of this parasite were collected from the small intestine of a kite—*Bulaster tisa* shot at Cuttack. Only one bird was found infested out of two examined. The species is characterised in having aspinose cuticle, smooth body margin and intestinal wall, sub-equal size of the two suckers and a long protruding cirrus.

**9. Field scale trials on the effect of Diazinon, Salicylic Acid and Benzoic Acid on wheat nematodes [*Anguina tritici* (Steinbuch, 1799) Filipjev 1936].**

A. S. SRIVASTAVA and K. P. KATIYAR, Kanpur.

Laboratory trials have indicated (Proceedings 43rd Ind. Sc. Cong.: Part III, 1956, page 286) earlier that .1% Diazinon, 0.03% Benzoic acid and 0.05% Salicylic acid in aqueous solution gave practically complete mortality of the wheat nematodes after 24 hours. In order to confirm this finding certain experiments have been conducted on field scale on wheat plants. The experimental wheat crop was heavily infested with this nematodes by sowing 15% cockles (by weight) with the seed. Certain plots were sown with clean healthy wheat seeds only in order to assess the loss in yield due to nematode infection. Each chemical was tried in 3 different concentrations viz., Benzoic acid .04%, .07% and .14%, Salicylic acid .05%, .08% and .16% and Diazinon .05%, 0.01% and 0.15%. One, two and three applications of these 9 different concentrations were given in different plots. Out of all these three chemicals tried, Diazinon alone was found effective; and its three applications reduced the percentage of infection from 30.6% (in control) to 2.48% at 0.15% level of concentration. But at the same time it was observed that Diazinon in this concentration was phytotoxic to the wheat plants as it had partially burnt the foliage and the grains from Diazinon treated fields were of reduced size. The weight of 100 normal grains from healthy plots is 3.5591 gms. while from those plots receiving 3 applications of Diazinon of .15% concentration it is 2.1489 gms. Further field experiments are in hand in this connection.

**10. On some new forms of the order Caryophyllidea from fresh-water fishes of India.**

S. P. GUPTA, Lucknow.

Five remarkable species of the order Caryophyllidea from the intestine of Siluroid fishes of U.P. and Assam have been described, four of which are referred to a new genus and the fifth to the genus *Lytocestus*. Out of these one new form belongs to the family Caryophyllaeidae, Leuckart 1878, and the rest to the family Lytocestidae, Hinnter 1927. This group of Cestodaria has been given considerable attention during the past years by several European workers as Nybelin (1922), Woodland (1923, 24, 26), Fuhrmann and Baer (1925), Hunter (1927) and others. Moghe (1925, 31) described only one new form *Lytocestus indicus* from a fresh water fish *Clarias batrachus* (Linn.) and placed it under the family Lytocestidae. Since then no other form of this group has been described. The present paper contains the description of the new forms in detail, with the necessary figures, sections and with a discussion of the systematics of the families of the order Caryophyllidea.

**11. A new species of *Bipalium* from Nepal.**

P. N. SAXENA, Patna.

This land planarian is found in Nepal at the height of 4000 ft. to 9000 ft. above sea level. It is available from July to October. It exhibits slow movement and at times changes direction of its locomotion after feeling the surface by lateral swing of the semilunar head. Body is light brown to grey in colour and varies in length from 80 mm. to 200 mm. by 3 mm. to 5 mm. across broadest

part of the body. A median dorsal and two lateral dark stripes extend from neck to posterior end. Ventral surface is of lighter shade. Creeping sole extends from neck to posterior end and is slightly raised. Head margin is provided with numerous ciliated grooves and lacks the row of eyes. Thirty to forty eyes in the form of black dots are present in the folds of the darkly pigmented neck and few on the ventro-lateral sides a little back. Pharyngeal cavity is extremely large and the pharynx always remains protruded through the mouth. Position of mouth varies greatly. Temporary mouth apertures are formed in majority of cases and the pharynx protrudes from them. From a thorough comparison with the reported species, it appears to represent a new species and hence named as *Bipalium keshavi* Saxena.

**12. On the study of embryonation in the eggs of the Pseudophyllidean cestode, *Diphyllobothrium latum* (Linnaeus, 1758).**

L. N. JOHRI, Delhi.

The embryonation of Pseudophyllidean eggs in the laboratory has been a difficult proposition on account of numerous complications involved in it. The present investigation is undertaken to overcome the handicaps in the embryonation of eggs leading to the formation and hatching out of complete coracidia. The eggs from the fresh strobilae of *Diphyllobothrium latum* were collected and kept in cultures at control temperature for embryonation. Another series of cultures was kept for embryonation of eggs collected after the aeration of strobilae (same as above) for several hours. Progressive development of the embryos commencing from the minute spaces in the egg to the formation of the specialized area, embryonic hooks, embryophore, ciliated coating and the final establishment of the coracidium together with its escape out of the opercular end of the egg is thoroughly dealt with. The percentage of hatching into coracidia is higher in the aerated eggs than that in the non-aerated ones as shown in a separate table. Attack of bacteria greatly retards the growth of the embryos. Use of sterilized equipment for the cultures serves a safety measure to a considerable extent. Progressive growth of the embryos is shown in the chart.

**(v) Entomology**

**13. Notes on Sandflies.**

R. D. MITRA, Poona.

A sandfly survey of Poona District was made from March 1951 to December 1953. The territory surveyed is about 230 square miles. It lies on the east of the Western Ghats (Map reference 18° 15' to 18° 45' N, 73° 30' to 74° E). During the survey 6126 sandflies were identified. *P. argentipes* and *P. papatasi* are found throughout the year. *P. argentipes* is found mostly in the cattlesheds and *P. papatasi* in the houses. The new species of *Phlebotomus* viz., *P. smithi* and *P. thapari* have been found here. A new variety of *P. argentipes* i.e., *P. argentipes* var. *glaucous* and a new variety of *P. squamipleuris* i.e., *P. squamipleuris* var. *poonaensis* have also been found here. Four species of parasitic mites were found on sandflies during the rainy season. Out of this, infestation by *Raphignathus smithi*, a new species of white mite was common. *R. smithi* attacks both sexes

of *P. papatasi*. The larvae of mites infest insects but *R. smithi* attacks sandflies in the adult stage. Some specimens of an unidentified species of Nematode were found in the fore and mid-gut of a *P. papatasi*. Presence of large numbers of *P. argentipes* in the cattlesheds and its scarcity in the houses indicates that this species feeds on cattle in preference to man, while scarcity in the cattlesheds and predominance in the houses of *P. papatasi* denotes that this species is anthrophilic. *P. papatasi* bred in the laboratory feeds on man after 24 hours of emergence, similar specimens of *P. argentipes* do not feed on man unless starved. Out of 37 samples of soil examined for sandfly larvae only one sample of moist sticky clod of clean earth, obtained from floor cracks away from the cow shed, was found to harbour sandfly larvae. Gravid specimens of *P. argentipes* and *P. papatasi* were found throughout the year. Only one gravid specimen of *P. thapari* was found in the month of March.

*P. argentipes* and *P. papatasi* are found here in large numbers throughout the year. Clinically the local fever resembles a mild type of sandfly fever but there is no evidence to incriminate the sandfly as its carrier apart from the fact that during the onset of this epidemic many *P. papatasi* are found in the area and most of these frequent the dwellings of man. The climate in this area is unsuitable for transmission of Kala-azar. It remains favourable for the transmission of sandfly fever during and after the rainy season. Lack of reservoir of sandfly borne diseases and zooprophyllaxis provided by the enormous number of cattle present in this area are other factors against the occurrence of these diseases here.

#### 14. On the Morphology and Histology of the Alimentary Canal of the Common Indian Yellow Jacket Wasp., *Polistes hebraeus* Fabr.

S. S. SEHGAL, Delhi.

This wasp is commonly found throughout India and is studied as a 'Type-form' in almost all the universities of India. The alimentary canal of *Polistes*, like that of most of other insects, is divisible in three primary regions: the foregut or the *stomodaeum*, the mid-gut or *ventriculus* and the hind gut or the *proctodaeum*. The fore-gut consists of the pharynx, oesophagus, crop and proventriculus. The pharynx is situated in the head capsule and works as a suction pump. Oesophagus is a narrow tube, which after traversing the thoracic cavity, connects the pharynx with the crop, that lies in the abdomen. The crop is a dilation of the oesophagus and stores the food. The proventriculus is narrow pedicel which connects the fore-and the mid-gut. Its posterior region projects inside the mid-gut in the form of a cardiac valve. The mid gut or the ventriculus is the most important region of the alimentary canal where most of the digestive and absorptive functions are performed. It is a U-shaped tube, annulated externally. The hind-gut or the proctodaeum is divisible into two regions: the intestine and the rectum. The intestine is a narrow tube which forms a pyloric valve with the mid-gut. The rectum has on its anterior half six white rectal papillae which help in absorption of water. A pair of cream-coloured labial or the salivary glands is present in the thoracic region. Histology of the different parts is given in the paper.

#### 15. Genital organs of the earwig, *Labidura* sp.

KUSUMAVATI KADAM, Delhi.

The 7th abdominal segment in the female and 9th abdominal segment in the male are modified as the genital segments. The 10th abdominal segment in both

the sexes is modified into unjointed forceps. The male genitalia consists of chitinous parameres that help in gripping the female copulatory organs. The penis is paired but only one is functional. The copulatory organs are enclosed in a genital chamber, the opening of which lies in between the 9th and 10th sternites. A number of extrinsic and intrinsic muscles, which move these organs individually, are described in the paper. The female genitalia consists of a pair of ovaries, each ovary is made up of five polytrophic ovarioles, the ova being arranged lengthwise. Spermatheca receives and stores the spermatozoa. Bursa copulatrix receives the penis and the associated parts during copulation, the spermatozoa are discharged into it before they enter the spermatheca. Copulation has been observed during the months of June and July. The male chases the female for some time and then pushes its forceps under the forceps of the female, which brings about the hind body segments of the male in close contact with the ventral side of the posterior body segments of the female. While in this position, the genitalia emerges from the body of the male and comes in close contact with the female genitalia. Copulation lasts for about an hour.

**16. Preliminary observations on the incipient primary colonies of the termite *Microtermes mycophagus* (Desneux).**

H. S. VISHNOI, Delhi.

The paper deals with a successful method of growing primary colonies of the termite *Microtermes mycophagus* (Desneux) from the dealate males and females collected from swarms. Ten such colonies were started in the last swarming season. Within 24 hours of their introduction into the jars the dealate pairs constructed small royal cells just at the bottom. The royal cell was easily visible through the glass wall in each case, and this affords a remarkable facility in observing the activity of the termites from time to time without disturbing the colony. The eggs were laid on the third day, the first clutch consisting of about a dozen eggs. Subsequent eggs were laid after a lapse of 2-4 days. First nymphs hatched in 22-23 days. Mature workers appeared in 13-15 days, and the soldiers in 20-23 days after the first nymphs hatched out. A colony is almost fully established in two months time when it consists of nearly 100 individuals, the workers and soldiers forming respectively approximately 35% and 6% of the total population. Small fungus combs were also found to have been grown close to the royal cell. At this age the termites extend the nest-limits building a network of concealed and exposed earthen tunnels. Further development of these colonies is under observation.

**17. Form perception in *Papilio demoleus* L.**

VIDYADHAR G. VAIDYA, Poona.

Freshly emerged imagines of *Papilio demoleus* L. kept in a large cage, were offered some circular patterns of different sizes and different 'amounts' of contour, cut out of coloured papers of the standardized Ostwald series. On these coloured patterns the hungry insects showed a characteristic feeding response: each one approached a pattern in flight, landed on it and unrolled its tongue with which it performed probing and sucking movement on the paper. Such responses on each pattern were counted separately. The results clearly show that even in the absence of the mathematical ability of counting and calculating, this insect can distinguish between forms of different sizes (at least as far as the dimensions used

in these experiments are concerned), and between forms presenting different 'amounts' of contour. Other conditions being equal, the attractiveness increases with the increase in size of the form, and with its compactness. The tendency of preferring a compact form (offering less contour) to a broken one increases with less and less attractive colours and vice versa. Some experiments have brought out clearly the difference in reaction to the 'amount' of contour, shown by this insect (a Papilionid), and the Vanessids (Ilse, 1932). They have also provided an experimental proof for the field observations made by Leppik (1953), that butterflies and moths prefer for feeding, flowers with a corolla-tube protecting the nectar deposits.

**18. On the reproductive system of *Luciola gorhami* Ritz.**

P. N. SAXENA, Patna.

In *Luciola gorhami* both the sexes are winged. Males are characteristically provided with two luminous segments whereas the females with only one. Other external distinguishing features of the two have been given in the text. The male reproductive organs comprises a single median testis, vasa deferentia, seminal vesicles, ductus ejaculatorius ending in a muscular penis. A pair of accessory glands, each consisting of four lobes, are associated with the vasa deferentia. It is significant that the seminal vesicles are situated at the anterior most end of vasa deferentia which lose their connection with the testis at a very early stage. The female reproductive organs consist of a pair of ovaries, lateral oviducts, oviductus communis, receptaculum seminis, large bursa copulatrix and an accessory gland. Each ovary consists of about 16 ovarioles. The number and arrangement of ovarioles is interesting and not commonly met in other beetles. The lateral oviducts are uncommonly wide and long. The vagina is small and comma " , " shaped. The spermathecal duct despite opening into the bursa copulatrix, opens directly into the vagina. A single small accessory gland opens into the vagina. The histological details of the reproductive organs have also been included in the paper.

**19. On the association of the red ant, *Oecophylla smaragdina* Fabr., with the tea Coccid, *Coccus hesperidum* L.**

R. N. GANGULI, Assam.

The association of ants and coccids has been regarded by various workers as mutually beneficial, ants deriving honey-dew excreted by coccids and in return protecting the latter against their natural enemies. The author in his observations on the relationship between the ant *Oecophylla smaragdina* and the coccid, *Coccus hesperidum*, which occurs abundantly on tea seed trees, confirms the view of Way (1954) that on the ant-free colonies the disappearance of the scales is primarily due to contamination with honey-dew and subsequent growth of sooty-mould but not due to increased rate of parasitization and activities of the predators, as believed by many earlier workers. Degree of parasitization is undoubtedly increased in ant-free colonies, but this is a contributory factor rather than the cause of disappearance of the scales. It has been estimated that contamination with honey-dew and sooty-mould growth are responsible for nearly 78.2% mortality of the scales within 15 days of disassociation from the ant, whereas insect parasites and predators cause 17.8% and 6.2% mortality respectively within the same period. In colonies of *C. hesperidum* attended by the ant *O. smaragdina*,

predatory insects are totally absent, though in colonies of *Eriochiton theae* Green, (another scale insect, attacking tea seed trees, attended by the same ant) *Eublema* predators may occasionally be found.

**20. Studies on a Braconoid ecto-parasite, *Microbracon hebetor*, Say—1.**

K. KANUNGO, Cuttack and G. C. SENGUPTA, Bhubaneswar.

Life cycle of the braconoid parasite, *Microbracon hebetor* Say was studied at 29°C with the larvae of *Coreyra cephalonica* as host. Eggs hatched in one day, grub stage lasted for 2 days and pupa stage for 2-3 days. Adults were light black in room temperature, dark in lower and brick-red in higher temperatures. Construction of "feeding tubes" by females was observed both in covered and naked hosts. Mating mostly occurred soon after the emergence of the adult and did not exceed 30 seconds. The urge for oviposition appeared to be mostly internal. Number of eggs laid by a female per day varied from 1-48 with an average of 12. Many eggs were deposited at a time in a single act of oviposition. Oviposition period, in case of mated females lasted from 6-49 days and with unmated ones from 14-25 days. Total number of eggs laid per mated female ranged from 35-658 with an average of 415. Pre-oviposition period lasted from 4-12 hours and post-oviposition period from 12 hours to 5 days. Out of 856 cases of parthenogenetically laid eggs studied, only one female emerged and all others were males.

**21. Studies on a Braconoid ecto-parasite, *Microbracon hebetor* Say II. Host density, age of the female and refrigeration in relation with fecundity.**

K. KANUNGO, Cuttack and G. C. SENGUPTA, Bhubaneswar.

Fecundity of *Microbracon hebetor* Say was studied in relation with host-density, age of the female and refrigeration with *Coreyra cephalonica* (full grown larvae) as host. Maximum number of eggs was found deposited with 2 hosts. Age of the female also had effect on fecundity. Because 15-day and 25-day-old females laid only 8 and 4 eggs on average respectively during their first 24-hours period of oviposition whereas the normal average number was 12. Hence prolonged restraint of oviposition yielded few number of eggs which might be due to absorption of eggs in the system of the female parasites. Similarly refrigeration also affected the fecundity of the parasites. Adults emerged from 15-day refrigerated pupae in rd generation did not lay any egg; neither could they paralyse the host supplied to them. Brachypterous adults also emerged from such refrigerated pupae. Such abnormal males thus emerged could not mate with normal females. The female brachypterous ones emerged in the same way, likewise could neither lay egg nor paralyse the host, supplied to them.

**22. Influence of insect infestation on some biochemical and physical properties of husked, hand-pounded, milled and parboiled Rice.**

S. V. PINGALE, S. B. KADKOL, M. NARAYANA RAO, M. SWAMINATHAN  
and V. SUBRAHMANYAN, Mysore.

Husked, hand pounded, milled and parboiled milled samples of rice obtained from the same strain of paddy (Halubbulu) were infested by *Sitophilus oryzae* (rice weevil) for a period of eight months and the changes brought about in the

different samples of rice due to infestation are reported. The results show that dehusked rice attracted a larger number of insects and developed an unhealthy appearance within two months of infestation. Parboiled and milled samples of rice were found to be least susceptible to infestation. Infestation of the rice grain increased the loss of starch in the gruel, it being maximum in the case of dehusked rice. No significant difference, however, was observed in the effect of infestation on other constituents of the grain, such as total nitrogen and soluble nitrogen. From the results possibility of correlating weight volume ratio of uncleaned grain, proportion of dust, loss in total weight, loss in thiamine and insect population is indicated.

**23. Some observations on the copulation and oviposition in *Lipeurus tropicalis* Peters (Mallophaga).**

G. I. ARORA and NARINDER CHOPRA, Hoshiarpur.

The present paper deals with some interesting observations on copulation and oviposition recorded while making a study of the life history and morphology of *Lipeurus tropicalis* Peters which is the common bird louse of the Hoshiarpur fowl. Observations on these lice were made both on the bird itself and in experimental jars kept in incubators at different conditions of temperature and at a relative humidity of 80-85%. Copulation starts 2-4 hours after the emergence of the adults when the male approaches the female from behind and comes to lie under the abdomen of the female, clasping the latter by means of its hooked antennae and inserting its aedeagus into the vagina by bending the terminal part of its abdomen upwards, forwards and below the female genital orifice; the female remains passive for most of the time. The first egg is laid 2-3 days after copulation. The female cuts through the barbules at the base of the barb, gives out a sticky fluid through her genital opening and passes out the egg to be implanted at the place where the barbules were previously cut, the viscid secretion gluing it there. The process is repeated and as many as 3-5 eggs are laid in a day each at an interval of 5-7 hours. The number of eggs laid every day by fertilized females and the life of the adults (both male and female) under different conditions of temperature have been recorded. It has been observed that the optimum temperature for egg-laying and subsequent life history is 35°C, that the average life of the male and female is 12 and 16 days respectively and that the total average number of eggs produced is 23 per female. A rise in temperature decreases the life span of the individuals but increases the daily egg rate whereas a fall in temperature decreases both the longevity and the daily egg rate.

**24. Comparative efficacy of some modern insecticides against *Atteva fabriciella* Swed., a sporadic pest on *Ailanthus excelsa*.**

A. S. SRIVASTAVA and G. P. AWASTHI, Kanpur.

*Atteva fabriciella* Swed. is a serious pest of *Ailanthus excelsa* an ornamental plant growing in the plains of Uttar Pradesh. The pest is sporadic in nature. No control measure of this pest has so far been known. In order to find out suitable and effective insecticides for the control of this pest, a number of chemicals were tried on the caterpillars of *Atteva fabriciella* in the laboratory and the mortality of the caterpillars noted 24 hours after treatment. The control after 24 hours with 01% Folidol E603 was 100%; with 125% Diazinon (Basudin) was 30%; with



·125% Endrin was 10% ; with ·5% DDT (50% water dispersible powder) was 30% ; with 1% BHC (50% water dispersible powder) was 100% ; with 0·25% Nicotine sulphate mixed with 1·25% Til oil and 0·25% soap was 100% and with ·125% Malathion was 20%. The trial has shown that Folidol and Nicotine sulphate are both equally effective at much lower concentration than BHC spray. Further field scale trials will be undertaken as soon as this pest appears in a serious form.

**25. Susceptibility to damage by *Nupserha bicolor postbrunnea* Breun. in *Sesbania aculeata*.**

N. DUTT, Barrackpore.

*Nupserha bicolor postbrunnea* has been reported after partition of India as one of the major pests of *Corchorus olitorius* (non-bitter jute) (Dutt, 1952, 1954). *Sesbania aculeata* an important green manure crop has been recorded as one of the alternative host plants of the pest. Incidence of the pest is also on increase on this leguminous crop of great economic importance. It is found that in case of *S. aculeata* the range of stem diameter susceptible to damage varies from 2 mm. to 7 mm. and this is much more than that observed in the C.G. variety of *olitorius* jute where the range varies from 2 mm. to 4 mm. only. In case of jute, it is found that the ratio factor between the mandibular length and the depth of extra medullary tissue of stem determines the range of stem diameter for damage. Highest damage per cent to the extent of 55·06 occur at that portion of the stem where the diameter falls within the range of 2·6 mm. to 3 mm. At this diameter range, the ratio of the mandibular length to the depth of the extramedullary tissue varies in the furrows and in the ridges of stem from 1 : 0·81 to 1 : 0·99 (Dutt, 1956).

In *S. aculeata*, unlike jute, the highest damage percent namely, 43·13 and 33·93 are recorded where the stem diameter ranges from 3 mm. to 4 mm. and from 4·1 mm. to 5 mm. respectively. In these stem diameter classes, the ratio between the mandibular length and the depth of extramedullary tissue of stem is 1 : 0·81 and 1 : 0·89 respectively. It thus tallies with the optimum ratio factor as is observed in case of *olitorius* jute, and as in the latter case, there is also reduction in damage percent in *S. aculeata* with gradual increase or decrease in the depth of the extramedullary tissue than that in the aforesaid optimum ratio.

It is thus evident that the ratio factor between the mandibular length and the depth of extramedullary tissue of stem determines the site of susceptibility on the host stem irrespective of stem diameter.

**26. Contrasting habits of mosquitoes and sandflies and their control with DDT.**

H. M. L. SRIVASTAVA, Lucknow.

Sandflies and mosquitoes both are susceptible to DDT. This has led to the belief that both the insects can be successfully controlled with a conjoint drive of DDT spraying. The paper deals with the contrasting habits of sandflies and mosquitoes indicating that frequency, formulation and site of treatment of insecticidal spraying would differ in the two cases. It has been stressed that separate programmes of spraying should be chalked out against each of the insects taking into consideration the nature of their habits.

**27. Hydrogen ion concentration in the salivary glands of few species of Anopheline mosquitoes.**

H. M. L. SRIVASTAVA, Lucknow.

Lal and Srivastava (1955) reported hydrogen ion concentration in the salivary glands of two Anopheline mosquitoes viz., *Anopheles culicifacies* and *A. annularis*. In the present work the above observations were extended to two more species of Anopheline mosquitoes viz., *A. stephensi* and *A. subpictus*. The findings conform to the following observations already recorded in the case of *A. culicifacies* and *A. annularis*.

1. The median and lateral lobes of the salivary gland show variable pH values.
2. The pH of salivary glands differs considerably in different species of Anopheline mosquitoes.

**28. Contribution towards the Odonata fauna of Pilani.**

J. P. AGARWAL, Narnaul.

This paper forms a report of the studies of a collection of Odonata. Altogether 15 species representing 12 genera are dealt with, of which two species are new and our new records. Notes on other known species have also been added.

**29. Notes on the biology of *Triatoma rubrofasciata*.**

P. SEN, Calcutta.

The paper deals with certain observations in the life history of the Reduviid bug *Triatoma rubrofasciata*. The female laid 20-25 eggs in two batches under laboratory conditions. Eggs were oval in shape and transparent, turning light brown in 3 or 4 days' time. Egg stage lasted for 15 to 17 days. Mortality among eggs was high. There were six nymphal instars: the first instar took a fortnight, the others a month or more each. Adult males in the brood were of smaller size—and they have lived on rabbit or guinea pig blood for eight months and are still active. Feeding methods have been described. It takes 12 to 15 minutes for the adult to engorge itself.

**30. Toxicity of some indigenous oil seed powder on house fly maggots (*Musca nebulo*)—Part I.**

Z. H. OSMANI and M. B. NAIDU, Hyderabad-Deccan.

In order to find out a larvaecide of vegetable origin for the control of house fly larvae a number of indigenous oil seed powder whose oils are reported to be insecticidal in nature have been tested for toxicity under laboratory conditions. Seed powders were mixed in different concentrations with the larval media and introduced in it a known number of eggs after wetting. It has been found that 10 per cent *A. squamosa* seed powder causes hundred per cent mortality of the larvae in three to four days after seeding. Seed powder of *P. glabra* and *Datura* (yellow) causes hundred per cent mortality at 12 per cent concentration. At lower concentrations the pupae that are formed are very much smaller than the normal

pupae and the emergence of the flies is also delayed. Seed powder of *Datura* (white) was found to produce about 50 per cent mortality at 15 per cent concentration. *Croton tiglium* powder was found to have little toxicity even at higher concentrations.

**31. Effect of certain indigenous oils on housefly maggots (*Musca nebulo*)—Part II.**

M. B. NAIDU, Hyderabad-Deccan.

Laboratory experiments were conducted to study the effect of seed oils of *Annona squamosa*, *Pongamia glabra*, *Croton tiglium* and *Brassica nigra* on maggots of house fly (*Musca nebulo*) reared in the laboratory. Toxicity tests were done by placing house fly eggs between two layers of the media which has been previously mixed with the test oil. Formation of pupa was used as a measure of toxicity. The oil of *A. squamosa* seed at 1.5 per cent and at higher concentrations were found to cause hundred per cent mortality of the maggots and it has no cumulative effect on the maggots. Other oils were found to have little or no toxicity at the concentrations tested. No residual action has been observed on house fly maggots with the above mentioned oils.

**32. On the behaviour and sensory physiology of the pigeon louse, *Columbicola columbae* Linn. (Mallophaga).**

R. RAKSHPAL, Lucknow University.

The reactions of the pigeon louse to temperature, smell, contact, colours and light have been tested in a circular, glass-walled arena divided into two halves. The thermopreferendum has been between 33 and 36°C., and the higher temperatures are more strongly avoided in comparison to lower temperatures. The louse prefers cloth that has been in contact with the pigeon feathers to clean cloth. Kerosene serves as a repellent. When the louse is offered different surfaces, namely, glazed paper, tin foil, blotting paper, unglazed paper, voile, silk, or wool the woollen surface is preferred most. With regard to the coloured surface the louse avoids white surface in comparison to coloured ones and the black is preferred most. The dim lights are preferred by the louse while the strong lights either arrest or retard the movements.

**33. Free amino acids in the blood of red cotton bug, *Dysdercus koenigii* Fabr. (Pyrrhocoridae).**

K. N. SAXENA, Delhi.

In the course of study of nitrogen metabolism of hemipterous insects the free amino acids occurring in their blood have been determined and the observations on the adults of *Dysdercus koenigii* Fbr. (Heteroptera: Pyrrhocoridae) are recorded in this paper.

The blood of recently fed insects was collected and analysed by two dimensional paper partition chromatography. The amino acids detected in the blood are: Alanine, arginine, asparagine, aspartic acid, cystine, glutamic acid, leucine/Isoleucine, lysine, methionine, ornithine, serine, tyrosine and valine.

Details of the techniques followed are described in the paper.

**34. Body temperature of some Hemipterous Insects.**

K. N. SAXENA, Delhi.

The study of body temperature of certain hemipterous insects has been taken up in order to understand the factors governing the regulation of temperature in these insects under different environmental conditions. The species selected are : *Dysdercus koenigii* Fabr. (Heteroptera : Pyrohocoridae), *Leptocorixa varicornis* Fb. (Corixidae) and *Phrynomorphus indica* (Jassidae). The temperature of these insects was taken with a needle-type of thermocouple of Iron-constantan. In saturated air, between the 10°C and 35°C, the body temperature of the heteropterous insects, *Dysdercus* and *Leptocorixa* is almost the same as that of the surrounding air while that of the jassid, *Phrynomorphus*, slightly below that of the surrounding air. Below 10°C the body temperature of all the species is a little higher than that of the air.

In dry air the temperature of *Dysdercus* and *Leptocorixa* shows a depression above 20°C while the depression in the temperature of *Phrynomorphus* occurs at 15°C and upwards. The depression in the temperature is almost equal in all the three species.

The significance of the divergences in the temperature of these insects has been discussed in the paper.

**35. Methods of feeding, source and composition of the food of the red cotton bug, *Dysdercus koenigii* Fbr.**

K. N. SAXENA, Delhi.

The methods of feeding, source and chief organic constituents of the food sap of *Dysdercus koenigii* have been determined. Both nymphs and adults prefer to feed on the leaves or bolls of cotton plant. When feeding on the cotton leaf, the stylets of the insects penetrate leaf surface on the mid-rib or any other large vein and, passing intracellularly, they reach the phloem tissue from where the sap is sucked in.

The individuals feeding on cotton bolls penetrate their stylets much deeper in the tissue and they reach the central part of the developing seed from where the sap is drawn in.

The chief organic constituents of both the tissues as well as of the ingested food sap have been determined by paper partition chromatography. The carbohydrates present in the sap from the bolls are : raffinose, sucrose and glucose but no starch. On the other hand the phloem sap of the leaf contains only sucrose, and glucose. The free amino acids present in the leaf-sap are : Alanine, cystine, glutamic acid, glycine, histidine, lysine, and tyrosine. Native proteins are not present in the phloem-sap but present in the sap drawn from cotton bolls.

**36. Metabolism of synergised pyrethrum by insects.**

A. K. DUTTA GUPTA, Pilani.

Addition of piperonyl butoxide or aulfox-cide as a synergist for some insecticides, has been proved to increase the relative potency of insecticide. The present work was undertaken to compare the responses of the insects (*Calandra granaria* L., *Callosobruchus chinensis* L., and *Tribolium castaneum* Herbst.) to range of

concentrations of pyrethrum by itself, and to reduced concentrations of pyrethrum, the reduction being compensated by the addition of synergists. The toxicity of pyrethrum is enhanced by the addition of the synergist and it has been shown that the "unmetabolised increment" of the synergised pyrethrum is same as that of an insecticidally equivalent solution of pyrethrum alone.

The synergism observed between pyrethrum and piperonyl butoxide resembles in all respects that between pyrethrum and the mixtures of piperonyl butoxide and sulfoxide. Information from the tests of the mixtures having different ratios of synergists of pyrethrum, indicated that the potency of the mixtures remains unaltered by the compensating ratio of the synergists within the limits tested.

**37. Studies on the hydrogen ion concentration on the  $\alpha$ -amylase activity in the gut of *Trogoderma* larva.**

S. S. KRISHNA, Delhi.

The paper deals with the influence of hydrogen-ion concentration on the activity of  $\alpha$ -amylase in the gut of starved *Trogoderma* larvae older than the 4th instar. Details of the technique to eliminate the  $\alpha$ -amylolytic activity under different pH values, using the photoelectric colorimeter are given in the paper.

The  $\alpha$ -amylase activity is maximum at a pH 7.5 and gradually declines, on both the acidic and alkaline sides, till at a pH 3.5-4.5 the enzyme is not capable of digesting starch. In the hindgut,  $\alpha$ -amylase activity is detected only occasionally suggesting that this enzyme comes here from the midgut and its pH characteristics are similar to those of the midgut.

**38. Sucking mouth parts of a biting louse.**

S. N. RAYCHAUDHURI and JYOTSNA CHAKRAVARTI.

*Eomenacanthus stramineus nitzsch* (*Menopon stramineum*) is a common ectoparasite of fowl. The insects were collected from fowls kept for experimental purposes at the School of Tropical Medicine, Calcutta. The gut contents of several live specimens were examined from time to time and the contents revealed the presence of profuse quantity of blood. This finding was also corroborated from sections of the whole insects. The mouth parts are of sucking type. The structures of the mouthparts consist of a number of extrusible parts. The mandibles are well developed and are highly sclerotized. The maxillae and labium are reduced and are adapted by a lacinia. A four jointed maxillary palp is always present. The tip of the lacinia is excavated by a shallow groove into which there are innumerable sharply pointed slightly curved spines. The labium is produced into two flat lobes and the margin is fringed with fine hairs.

**39. On the biology and anatomy of the mouthparts, digestive and reproductive systems of *Hispa armigera* Oliver.**

S. N. ROYCHAUDHURI and NARESH CHANDRA DAS.

The rice hispa a common pest of paddyplant in West Bengal has been studied with reference to its biology and certain aspects of anatomy of the mouth parts, digestive and reproductive systems.

Field work and laboratory observations were done extensively on different food plants of hispa and the results were very interesting. The mouthparts are highly sclerotized. The distribution of different types of sensillae were also examined critically. Mandibular and maxillary glands are unicellular and open at the bases of mandibles and maxillae.

The intima of the oesophagus is produced into small conical chitinous processes. The discharge of the secretory droplets of the midgut epithelium is very significant and is dependent upon the nature of food. Well developed rectal glands are found. Origin of the malpighian tubules is very interesting as these open at two different regions of the alimentary tract.

Testes are bilobed spherical bodies. The vesicula seminalis is in the form of figure "8". Nine ovarioles are seen on each side. A well developed hook-shaped spermatheca is present. Spermathecal gland is absent. Ovipositor is spatulate with a groove in the middle bordered with innumerable pointed setae.

**40. On two new species of Trombiculid mites from a common cobra *Naja naja* in India.**

L. S. HIREGAUDAR, Bombay.

Two species, *Schongastia* (*Ascoschongastia*) *longisetosa* and *Tragardhula* *najai*, collected from a common cobra, *Naja naja*, are described for the first time from India. *S. longisetosa* resembles in some respects *S. bidentata* in the shape of the scutum but differs from it in having a different standard measurements. *T. najai* is characterised by the scutum much broader than in *T. gymnodactyla* and the standard measurements differing much from other species known under the genus *Tragardhula*.

**41. Application of insecticidal sprays to breeding sites for control of *Tabanus* flies.**

P. BALARAMA MENON, Izatnagar.

This paper reports the results of further attempts to control the breeding of *Tabanus* flies by the use of insecticides at the breeding sites. Different formulations of DDT, BHC, Lindane, Rhothane, Lethane and Parathion were used for this purpose. Nakatia river on Pilibhit and Shajahanpur Roads and Deorania river near Bilwa and the stream in Kareli Kargana, where fairly heavy breeding of *Tabanus* flies was present, were sprayed along the banks with the various insecticides. In most of the cases some reduction in egg laying was obtained, but they failed to control oviposition completely. Lethane 60 which is claimed to possess good ovicidal properties was also not very effective in controlling the breeding of these flies. Only Parathion was effective in reducing breeding to an appreciable extent though it, too, did not completely prevent oviposition.

**42. Effect of some of the newer insecticides on lice and ticks of domestic animals.**

P. BALARAMA MENON, Izatnagar.

In order to evaluate the insecticidal action possessed by them against ectoparasites of domestic animals, five insecticides viz., Rhothane, Lethane, Chlordane, Parathion and Lindane were tested in different formulations and varying dilutions on different species of arthropods infesting livestock.

Rhothane 25 per cent emulsion concentrate, used in a strength of 0.5 per cent, controlled lice infestation in goats (*Bovicola caprae* and *Linognathus stenopsis*) and lice and ticks on buffaloes (*Haematopinus tuberculatus* and *Hyalomma aegyptium*). Lethane 60 was found effective against lice on goats and buffaloes and Lethane B 72 on cows (*L. vituli*). Chlordane 5 per cent dust killed lice on goats, buffaloes and ass (*L. stenopsis*, *H. tuberculatus* and *H. asini*). No reinfestation was noticed for about ten days. Chlordane 75 per cent emulsion, at a strength of 0.5 per cent, gave satisfactory control of lice on cows and buffaloes (*L. vituli* and *H. tuberculatus*) and there was no reinfection for a week. Parathion 1 per cent dust killed goat lice *L. stenopsis*. Lindane 2 per cent dust and 6.5 per cent wettable powder were found effective against lice on goats and cows (*B. caprae*, *L. stenopsis* and *L. vituli*) and the animals remained free of lice for a fortnight.

#### 43. Studies on the fleas of Bombay rats.

P. J. DEORAS and M. S. GOKHALE, Bombay.

During 1954 and 1955, 4,567 rats brought to this Institute were brushed and 2,378 fleas, 79 ticks, 90 mites, and 33 lice collected. The fleas were *Xenopsylla cheopis*, *Xenopsylla astia*, and a very few specimen of *Ctenocephalides felis*. The ticks were *Rhipicephalus sanguineus*, and *Rhipicephalus tricuspis*. The mites were identified as *Dermanyssus muris* and *Laelaps echidninus*. The lice were *Polyplax spinulosus*. The data regarding the fleas was analysed statistically and the following conclusions were drawn :—

1. That *X. cheopis* and *X. astia* were the only fleas collected predominantly on these rats, and that *X. cheopis* was the most predominant rat flea of Bombay.
2. That *Rattus rattus* harboured most fleas as compared to *Bandicoota bengalensis* and *Rattus norvegicus*.
3. That the male fleas of *X. cheopis* predominated on all the rats, and that the females of *X. astia* were always more than the males. Further *X. cheopis* was found mostly on *Rattus rattus* and *X. astia* on *Bandicoota bengalensis*.
4. That the peak period of collection of *X. cheopis* was during April-May, while that of *X. astia* was in February-March of the years.
5. These findings confirm our observations done during 1953, and compare with similar findings of the Flea survey done by Webster and Chitre in 1930, though our methods were different.

#### (v) Fishes and Fisheries

#### 44. On the oesophagus of the Milk-fish, *Chanos chanos* (Forsk.)

M. CHANDY, Delhi.

In the Milk fish *Chanos*, the pharynx gives off on each side a cul-de-sac, the so-called pharyngeal organ, and passes into the oesophagus. The oesophagus from the outside presents a series of closely placed oblique striations which correspond to a series of inner mucosal folds, suggesting a spiral valve. Each fold of the spiral valve is a narrow strip of mucosa, supported by sub mucosa and oblique muscles. Histological study reveals that the mucosal epithelium is raised into

innumerable villi. Each villus is a finger-shaped structure made up of an inner layer of submucosa and an outer layer of mucosa, modified into unicellular glands or goblet cells. The whole organ is designed for copious secretion of mucus, which seems to have some correlation to the type of plankton feeding habits of this fish.

This type of oesophagus is a remarkable instance of functional morphology, as throughout the vertebrates, oesophagus is one of the least modified portions in the digestive system.

#### 45. Teratological notes on the five species of Indian Carps.

H. L. SARKAR, Delhi.

The teratological conditions of fishes are not uncommon and author has already reported four deformed specimens of the Indian Carp, *Labeo rohita* (Ham.).

The present communication deals with the following seven deformed specimens: *L. calbasu* (Ham.) (One), *L. rohita* (Ham.) (Two), *C. catla* (Ham.) (One), *C. mrigala* (Ham.) (Two) and *B. (Tor) pultora* (Ham.) (One).

The deformities of the external features and the vertebral column of the above mentioned fishes are studied. Attempt has been made to group the deformities of the vertebral column of these fishes. According to Stolk the fishes can be placed in different groups from the studies of the curvatures of the vertebral column. Out of seven fishes three are cases of lordosis, one kyphosis, two kypholordosis and one without any curvature. According to Gemmill's classification four specimens fall under the category in which the vertebral column is with no coalescence and with twisting and curvature. The remaining three fishes fall under the category in which the vertebral column is with coalescence or synostosis.

The causes of the deformities expressed by different workers, are included in the paper.

#### 46. Fresh water fishes of Gwalior.

TRILOK MAJUPURIA, Aligarh.

Very little is known about the fisheries of Madhya Bharat. Rivers, tributaries, canals and tanks covering an area of 66,000 miles and a canal system of 1,865 miles contribute to the wealth of fisheries in this province. This paper is a record of the investigation for the improvement of the fisheries. The Chambal is a rich source of supply for this region. The river provides very good fishing places near Morena. Common valuable carps move upstream from the Asan river which provides an ideal nursery for the fishes of Kheroli. Other breeding grounds are near Morar. Guinea worm is predominant in the southern circle of Madhya Bharat, which is due to the absence of larvivorous fishes in waters of Malwa. After year's exploration of tributaries 62 species of fresh water fishes were collected and properly identified. Some aspects of the development of the fisheries of Madhya Bharat are also given in the paper.

#### 47. On the early life history of *Mystus vittatus* (Bloch).

S. M. DAS and S. K. MOITRA, Lucknow.

The egg is demersal, transparent, spherical and large, with a diameter of 6 to 7 mm. The eggs are pale yellow and oil globules are absent from the perivitelline space.



line space. Under laboratory conditions, after 12 to 20 hours, the embryo ruptures the egg membrane and emerges as a free *hatchling*, measuring 4 mms. in length, with an oblong yolk sac and a continuous fin fold. The *pro-larva* after 24 hours is 5 mms. long and develops light pigment all over the body including the yolk sac. Eyes, one pair of maxillary barbels, and a rudimentary operculum is formed and the gut delineated at this stage.

The *larva* begins to feed from the third day and is 6 mms. long. On the fourth day the yolk sac is almost absorbed, maxillary and mandibular barbels both are present, the fins are clearly distinguishable and an adipose fin is present. The larva is about 9 mms. in length with a homocercal tail fin. The *post-larva* is the stage from the fifth to the seventh day, when the yolk is completely absorbed and the length increases to 10 mms. After the seventh day the juvenile characters appear and the *fry* stage may be said to have been reached.

#### 48. On the early life history of *Bagarius bagarius* (Ham.).

S. M. DAS and S. K. MOITRA, Lucknow.

The *eggs* are spherical and transparent with an iridescent yellow tinge and a diameter of 5 mms. There is no oil globule in the perivitelline space. The *hatchling* emerged after 12 to 15 hours in the laboratory, were 4 to 5 mms. long, considerably dark pigmented all over the body, and provided with a continuous fin fold. The *larva* on the second day is 5 mms. long, the continuous fin fold is broken up to form different fins, and fin rays appear. Development is so rapid that right on the second day the eyes get pigmented, the yolk sac gets reduced, the alimentary canal gets differentiated, the mouth opens, and rudiments of the operculum appear.

On the third day the larva is converted into the *post-larva* with complete absorption of the yolk sac, the post larva (6 mms. long) has fully formed operculum, the maxillary and mandibular barbels appear, stomach and intestine are differentiated and the mouth is provided with lips and numerous teeth with which they feed voraciously. The tail fin becomes very markedly heterocercal from the third day and the different fins with fin rays also appear. On the fourth and fifth days the juvenile characters start appearing. The barbels become well developed, the body becomes almost black in colour, the pectoral fins with rays are formed. The posterior end of the body now tapers as in the adult of the species, and the post larva shows marked tendency to cannibalism inspite of food being present. On the sixth day all the important juvenile characters appear and the 7 mm. post larva may be called *fry*.

#### 49. Spoilage of fish on board the fishing boats.

N. K. VELANKAR and P. V. KAMASASTRI, Mandapam Camp.

Bacteriological and chemical studies on the quality of fish in boat landings made on the Rameswaram Island were carried out. No preservation methods were employed on board in order to ensure that the fish remained in good condition when landed ashore. The samples of fish, collected from different boats, were transported in ice to the laboratory and bacterial count, trimethylamine, and total volatile nitrogen of the muscle were determined. The fishes examined included Dorab, Seer, Mackerel, and Butter fish *Lactarius*. The time interval between catching the fish and landing it ashore varied from 3-12 hours. The range of the

T.M.A., T.V.N. concentrations and bacterial count and the organoleptic condition of the fish was as follows :

T.M.A.	Nil	...	...	68.04 mgs N%
T.V.N.	11.28	...	...	91.46 mgs. N%
Bacterial count	Nil	...	...	Several million/gm.
Organoleptic condition	Very fresh	...	...	Decidedly stale

*Bacillus micrococcus* and Gram-negative achromic rods were mainly present in the muscle flora; a few chromogenic rods were also isolated.

A considerable proportion of the fish in the boat landings were on the threshold of spoilage. The observations stress the need for improvement in the handling and storage of fish on board the boats.

#### 50. Preservation of Mackerels in Ice.

N. K. VELANKAR and P. V. KAMASASTRI, Mandapam Camp.

The keeping quality of mackerels in ice under different conditions was investigated. In the round condition the fish remained in good condition upto two weeks as judged by the bacterial count, trimethylamine and total volatile nitrogen content of the muscle. The state of preservation was found to be better when ice containing 4 p.p.m. of aureomycin was used. However, in 20 days spoilage occurred using both ordinary and antibiotic ice. Gutted mackerels kept at least a week longer than round mackerels. When mackerels were not iced immediately but after allowing a lapse of about four hours after landing, the fish spoiled within three days in ice storage. Mackerels gutted as well as round, spoiled much more rapidly at 3-5°C than at 0°C, the spoilage at the former temperature being of a more pronounced nature. Bacterial flora of the muscle was composed mainly of *Bacillus* and Gram negative achromic rods; the latter appear to be more significant in causing spoilage at refrigeration temperatures.

#### 51. Notes on the development of the Carp *Barbus stigma*.

SARVENDRA DYUMNA KULSHRESHTHA and TRILOK MAJUPURIA, Aligarh.

The present paper is a record of some original observations on the development of *Barbus stigma* in Madhya Bharat. It is fairly abundant in inland waters of Madhya Bharat. Breeding was noticed several times. The developmental stages were collected from Orna Nala near Banmor. The development was observed in specially built aquaria. Field observations were also made to mark the differentiation. The breeding season of the fish is flood months of June, July and August. Weather report during development was also observed. Various stages of the development were recognised. Impregnated ova were found floating. After emergence from eggs larvae are more or less curved with head protruding and facing downwards. Larval development proceeds with the development of various organs which are well formed. During post-larval development all the larval characters were specifically developed. Development is marked by complete metamorphosis.

#### 52. On the nutrition of Carp fry of the Mahanadi River.

G. N. MITRA and I. DAS, Cuttack.

The value of artificial feed in rearing spawn in unfertile tanks has not been fully worked out. A group of 38 sandy loam tanks in a continuous chain were

selected and some of them were manured heavily. The production of plankton was poor. Stocking was done with carp spawn @ 300 trs. per acre and various artificial feed was used e.g. Til Oil Cake, Mustard Oil Cake, Rice Powder, Rice bran, Black gram, Silk Worm pupae, Weed Powder, Cotton seed meal and fish meal. It was found that til oil cake, black gram and rice powder gave good survival and growth. *Catla catla* grows best with natural food while *Cirrhina mrigala* required a protein rich diet. *Labeo rohita* and *Labeo calbasu* did well on carbohydrates.

#### 53. On the yield of fry from the Choudwar Tanks.

G. N. MITRA and J. C. PATRO, Cuttack.

Alikunhi, Mitra and Mahapatra, Mitra and Das, have recorded yield of fry from experimental nursery tanks. The Choudwar fish farm with a nursery area of 2.8 acres was manured after thorough netting with phosphatic and nitrogenous organic compounds and stocked at different rates. The optimum yield was from tanks with a higher rate of stocking. The average yield was recorded to be 273 Trs., per acre and the maximum (yield) 531 Trs., per acre. The farm yielded a net profit of Rs. 2,076/- in a period of three months.

#### 54. On the optimum yield of Carp fingerlings from nurseries.

S. K. MITRA, Cuttack.

Rearing of carp spawn in nursery tanks to a fingerling stage (1"—3") is a common practice in Orissa. The spawn is collected from rivers in spate at a stage of 0.5—0.7 cm. and released in small tanks ranging between 0.50—1.0 acre in size for survival and growth. Unlike in Bengal, the fingerlings are not thinned out at a stage of  $\frac{1}{2}$ " but allowed to grow until it reaches the required size. Attempts have been made to determine the optimum yield from nursery tanks at different rates of stocking with or without artificial feeding. It has been found that for a stage of growth of fingerlings upto 1.50 cms. from 0.5—0.7 cm. tanks with higher initial plankton give a higher average survival, where as tanks artificially fed yield more healthy fingerlings with higher average weight corresponding to the length. The feed was made up of a mixture :—Mustard oil-cake 25%, Til oil-cake 25%, Black gram powder 25%, Rice bran 10%, wheat bran 15%.

#### 55. Observations on the nutrition of the Carp spawn of the Mahanadi River.

I. DAS, Cuttack.

The nutritional requirements of early spawn of major carps of India are little known except that the spawn thrive on zooplankton of minute size. Rearing experiments of early spawn in aquaria with various combination diets with and without vitamins in zooplankton free water have been conducted and compared to results obtained with a feed of zooplankton. A mixture of simple protein and carbohydrate without roughage (50:30) has given best results, zooplankton, fresh liver, rice powder, fish meal being next in order in case of *Labeo rohita*, *Catla catla* and *Cirrhina mrigala*. *Cirrhina reba* seems to have different nutritional requirements and has grown only with zooplankton.

**56. Estimation of degree of spoilage in fish by means of X-rays.**

G. B. MOHANTY and S. PATNAIK, Cuttack.

Through this experiment a close study of the internal changes in the anatomical structures of fish according to the degree of spoilage has been made and a standard worked out to determine the spoilage by means of x-rays.

The method has given encouraging results in quicker and accurate detection of degrees of spoilage in fish.

**57. Determination of the rate of consumption of oxygen by spawn under variable temperatures.**

B. NAYAK and D. A. PATNAIK, Cuttack.

With the development of technique of transporting spawns from collecting centres in Orissa rivers to distant places by means of oxygen packed polythene bags, it was found necessary to determine the exact rates of consumption of oxygen by spawn under variable temperatures to save mortality.

It has been observed that between temperatures ranging from 20°C to 30°C the absorption of oxygen in water being appreciable the consumption rates also have been satisfactory, and as such the survival period has gone upto more than 36 hours. Experiments above 30°C as well as below 15°C have shown discouraging results.

**58. Notes on the frigate Mackerels, *Auxis thazard* (Lacépède) and *A. tapeinosoma* Bleeker, from Indian waters.**

S. JONES, Calicut.

Records of the occurrence in the Indian coast of the so-called, frigate mackerels, *Auxis thazard* (Lacépède) and *A. tapeinosoma* Bleeker, which are the smallest of the tunas are given in this note. *A. thazard*, which is a very widely distributed circumtropical species, has been found to be common in the southern section of Travancore. Specimens have also been obtained from Minicoy Island in the Laccadive Archipelago, Malpe in South Kanara and Mandapam in the Gulf of Mannar. *A. tapeinosoma* has so far been known only from the Pacific and a single specimen obtained from Malpe appears to be its first record from outside the above region.

**59. On the early life history of *Nemachilus zonatus* (Ham.).**

S. M. DAS and S. K. MOITRA, Lucknow.

The diameter of the spherical pelagic egg is hardly 4 mms., and the eggs hatch in the laboratory in about 10 to 15 hours. The hatchling is 4 mm. long, transparent, and with unpigmented rudimentary eyes. The species is characterised by the shape of yolk at this stage, which is oval in the anterior region but is produced into a thin elongated strip posteriorly. The pro-larva (36 hours), develops eye pigment, rudiments of the operculum and rudiments of the alimentary canal; but no mouth is formed. On the fourth day it may be called the larva, which is 5 mm. long, the yolk sac is nearly absorbed, the mouth and gut fully formed, and the operculum completed.

The post-larva, from fifth day onwards, has no yolk sac, dark pigments appear scattered over body, and rudiments of pectoral and pelvic fins appear. The tail

is homocercal and the post larva moves by shooting in jerks. The juvenile characters appear after the sixth day, when the post larva is 6 mm. long, and it may be called a fry.

**60. A preliminary note on the toxicity of gamma BHC on the frya and fingerlings of Mirror Carp.**

H. S. CHAUDHRY, Naini Tal.

The culture of carps is being recently introduced in certain parts of Tarai area of the Naini Tal district, where vigorous antimalaria measures and extensive use of larval insecticides are also going on simultaneously. The present paper deals with preliminary aquarium studies on the toxicity of one of such insecticides, the gamma BHC, on the frya and fingerlings of Mirror Carp (*Cyprinus carpio*) and Mahaseer (*Barbus* sp). These frya and fingerlings were subjected to the action of "Gammexane" dust D-025, which contains 5% of Benzene Hexachloride and 0.6% of gamma isomer of BHC, at certain intervals for 21 days. At the end of this period it was calculated that the mortality in case of Mirror Carp was 15-20% higher than the Mahaseer. The gamma BHC consequently seems to be more toxic to the Mirror Carps.

**61. Biological stability of "Colombo cured" fish.**

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

"Colombo curing" or "Jadi" curing is a particular method of preserving fish, widely practised in South Kanara, mainly for export to Ceylon. It is similar to "Marinading" in that an organic acid is introduced, though indirectly. Mainly mackerel, non-fatty sardines and seer are cured by this method. Salt is used in the ratio of 1:3 of fish. Fish remain in brine till they are required to be taken out for export, when they are arranged in barrels, pressed down, "self-brine" added and sealed up. During curing, salt and fish are also intermixed with the dried fleshy pod of *Garcinia cambogea* commonly known as "Kodapuli". The pH of the brine is lowered to 5.4. The product keeps well for over eight months to one year. It was free from *Staphylococci*. Normal mesophilic counts as well as halophilic counts were low, showing the bacteriological stability of the product. A very interesting observation was that gas forming anaerobes were present in the pickle and fish, but these did not digest the meat nor did they produce foul odours. But a fruity odour was discernible in the pickled fish and it is perhaps due to the favourable fermentative activity of the anaerobes. The flora of the Colombo cured fish and pickle was mainly made up of mesophilic aerobic sporeformers. There were very few *Micrococci* and a few asporogenous rods. With better handling and hygiene the product can be stable for longer periods.

**62. Investigation on the quality of salted fish sold in the markets.**

R. VENKATARAMAN and A. G. VASAVAN, Kozhikode.

Properly salted fish should remain in good condition for at least three months. But most of the salted fish available in our markets fall short of this standard because of the inefficiency of curing.

To investigate this representative samples of salted fish were collected from two markets in Kozhikode town. The quality was examined, by an analysis for moisture, salt and T. V. B. (Total Volatile Bases) and organoleptic tests. The

collected samples were kept under observation and it was observed that most of the samples went bad within two months due to red attack and decomposition. The major defect in most of the cases studied was insufficient drying. To remedy this better initial drying as well as periodic drying of the fish stored in godowns, if possible is suggested. The beach drying (without application of salt) of small fishes like white bait is found to be a poor method of preserving them.

**63. Studies on the manufacture of semi dried prawns, with reference to the levels of moisture and sodium chloride in the finished product and the percentage yield.**

R. VENKATARAMAN and A. G. VASAVAN, Kozhikode.

Semi dried prawns are prepared by blanching and shelling the prawns and drying the pulp obtained. The levels of moisture and sodium chloride in the different stages of processing are estimated and the percentage yields for different species at varying moisture contents were worked out. The yield of finished product and the sodium chloride content 20-25% (on dry basis). The yield of raw pulp varied from 15-20%. The moisture content in the finished product was 40-45% was 30-40% of the weight of raw prawns and the weight of dried pulp was 55-65% of the raw weight of the pulp. A study of the keeping quality of semi dried prawns at various levels of moisture content was also made and it was observed that a moisture content of 42-5% is the optimum considering the keeping quality and the texture of finished product.

**64. Inhibition of bacteria from marine sources by aureomycin.**

N. K. VELANKAR, Mandapam.

The effect of aureomycin at levels of 2, 5, 20 and 50 parts per million was observed in the case of about fifty bacterial spp. isolated from the marine environment and from fresh and spoiling sea fish. With the exception of three all the bacteria were sensitive to aureomycin, 40% at 2 p.p.m., 30% at 5 p.p.m., and 30% at 20 or 50 p.p.m. The period of lag before growth occurred on agar slants at room temperature (about 27°C) varied from  $\frac{1}{2}$  to 4 days. Bacteria sensitive to 2 p.p.m. included species of Gram-negative achromatic rods, (motile with polar or peritrichous flagellation, or non-motile) *Vibrio*, *Flavobacterium*, *Bacillus* and an agar digester resembling *Cytophaga*. Yellow, red and violet pigment producing rods and denitrifying *Pseudomonas* spp. were sensitive to 5 p.p.m. or higher levels.

The cocci were more resistant than the Gram-negative rods. Sensitivity to aureomycin varied greatly in the *Bacillus*. A black pigment producing yeast was insensitive and two *Nocardia* spp. were slightly sensitive to aureomycin. At the level of 50 p.p.m. aureomycin prevented growth indefinitely in a number of bacteria belonging to different types, the action at this concentration being probably bactericidal; in the cocci however growth was often delayed but not prevented indefinitely at 50 p.p.m.

Plate counts of fish slime on aureomycin containing agar showed reduction to  $\frac{1}{3}$ rd at 2 p.p.m. and to  $\frac{1}{25}$ th at 5 p.p.m. In sea water samples the count was reduced to  $\frac{1}{5}$ th at 2 p.p.m., to  $\frac{1}{20}$ th at 5 p.p.m. and to nil at 20 p.p.m. In sea water to which aureomycin was added (20 p.p.m.) the count after 24 hours at room temperature was  $\frac{1}{4}$ th that in the control, but the bacteria present in the aureomycin-treated sea water were limited to a very few species unlike in the untreated sea water.

The probable implication of these observations on the use of aureomycin in ices and in "initial dips" for fish preservation is discussed.

**65. The Pearl Fishery conducted off Tuticorin in 1956.**

P. I. CHACKO, Madras.

An inspection of 11 pearl banks off Tuticorin in November-December 1955 revealed the presence of about 8 lakhs of oysters on the Tholayiram, par, the majority of which were above 3 years in age and mature for fishing. A pearl fishery was, therefore, inaugurated on 27th February 1956 and lasted till 17th March 1956. On 18 days of pearling 21,29,058 pearl oysters were fished. By sale of the Government share of two-thirds of the catch a gross revenue of Rs. 45,455 was realised. The expenditure incurred for running the fishery was Rs. 4,385. The pearl-content of the oysters was good; and the largest pearl weighed 2.26 carats. 457 divers in 46 boats participated in the fishery. The healthy co-operation of the diving force contributed much to the success of the fishery.

**66. Some new observations on the Circulatory System in *Amphipnous cuchia* Ham.**

AMAL K. MUKHERJEE, Calcutta.

The circulatory system of air-breathing teleostean fishes offers interesting modifications, in correlation with their breathing habits. Here are some observations, hitherto unknown, on the circulatory system of *Amphipnous cuchia* Ham. The gills and gill-slits being greatly reduced in this fish, branchial respiration has given place to aerial mode of respiration with consequent modifications of the circulatory system.

The ventral aorta on its course to the pharynx gives out a large number of small vessels to the body muscles, and a single large vessel to the oesophagus. In the pharyngeal region, it gives out four pairs of afferent branchial arteries, of which the 1st and 2nd pairs supply the air chambers. The 4th afferent branchial arteries curve directly downwards to form the dorsal aorta. The blood from the air chambers is returned by the jugular veins. It is seen that the skin is richly supplied with blood vessels and it is likely that it subserves as an accessory respiratory organ.

**67. Action of certain enzymes on the gonadotrophic activity of the pituitary extracts of the Indian Catfish *Heteropneustes*.**

L. S. RAMASWAMI and B. I. SUNDARARAJ, Bangalore.

Ever since the work of McShan and Meyer (1938), proteolytic enzymes like trypsin and pepsin, and amylolytic enzymes like ptyalin have been widely used to get pure or nearly pure preparations of pituitary gonadotrophins. Trypsin and pepsin inactivate the luteinizing factor, while ptyalin inactivates the follicle stimulating factor. The previous investigations have centred around the mammalian pituitary. We wanted to determine the action of these enzymes on the pituitary extracts of the common Indian catfish *Heteropneustes fossilis* (Bloch). Four sets of experiments have been carried out. In our first experiment, the enzyme digestions were made for three hours at 30°C at pH 6.8. In our second and third experiments the enzyme digestions were made for four hours at 37°C at pH 6.8. In our fourth experiment the enzyme digestions were carried out for six hours at 37°C at pH 6.8. Pepsin digestions were made both in alkaline and acid media. Undigested incubated controls were also simultaneously run. A total dose of 2 c.c. of each extract was injected into gravid female *Heteropneustes*. Specimens injected with control and ptyalin digested extracts spawned profusely in the aquaria, while injections of trypsin and pepsin digested extracts did not.



elicit spawning. So, even in fishes trypsin and pepsin largely, if not entirely, destroy the luteinizing activity of the pituitary extracts.

Ptyalin does not destroy the luteinizing activity. This enables us to conclude that the pituitary of *Heteropneustes* also secretes the gonadotrophic hormones, the follicle stimulating and luteinizing, very much like that of mammals.

**68. A histochemical study of the pyloric caeca of *Ophicephalus punctatus* (Bloch).**

T. S. PILLAI and A. R. KASTHURI BAI, Bangalore.

The precise function of the pyloric caeca of *Ophicephalus punctatus*, whether digestive or absorptive, is uncertain; and a histochemical study is undertaken with a view to solve this physiological problem.

Specimens of pyloric caeca were prepared for histochemical demonstration, and the alkaline phosphatase was revealed with the method of Gomori. Several incubation periods were used to get the maximum reaction without diffusion artefacts. Observations showed that there was a gradual increase in the activity of the enzyme at the striated border as the period of incubation was raised upto a certain limit. After half an hour incubation, border reaction was intense showing distinctly the outlines of the goblet cells and extending for a fair distance into the crypts. No other structure including the golgi zone gave a reaction upto 30 minutes' incubation. Diffusion was markedly evident beyond one hour incubation period. By means of PAS technique the presence of mucopolysaccharide, not digestible by diastase, was discovered in both the striated border and the crypt lining. The cytoplasm of the epithelial cells stained lightly.

The distribution of alkaline phosphatase in the cuticular border of the pyloric caeca is just the same as in that of the intestine. If in the small intestine the presence of the enzyme at the striated border has a functional relationship to glucose absorption then it can be reasonably asserted that the same relationship holds good in the case of the pyloric caeca as well. The pyloric caeca can then be ascribed an absorptive function and the development of the caeca, as reported by earlier authors, is correlated with the need for the increased absorptive surface to make up the deficiency due to the shortness of intestines. The existence of periodic acid-schiff reactive substance at sites of intense alkaline phosphatase indicates, as Moog and Wenger (1952) point out, that both these are closely interrelated from a physiological point of view.

**69. Cranial osteology of Cat fishes. Part II: Development of chondrocranium in two members, *Mystus* and *Rita* of the family Bagridae.**

H. R. SRINIVASACHAR, Bangalore.

The chondrocranium of *Mystus* and *Rita* of the family Bagridae, forming the second part of my studies on the cranial osteology of Cat fishes, is described in this paper. The fully formed chondrocranium of *Mystus* is compared with a similar stage of *Rita* with a view to find out if these characters are of classificatory value.

In *Mystus* the chondrocranium is fully formed in 20 mm. stage when all the cartilages are completely formed. In the ethmoid region an extensive tectum or tegmen is noticed forming a roof for the anterior part of the brain. A distinct nasal septum is seen extending posteriorly from the lamina precerebralis. The olfactory foramen is very much reduced. A large sphenoid fissure is observed behind the pre-optic root of the orbital cartilage, through which passes the optic, oculomotor, abducens and the branches of trigeminal and facial nerves as in other



siluroid (Srinivasachar, 1956). The plate-like orbital cartilages are connected dorsally by an epiphysial bar which does not show any trace of taenia tecti medialis. The auditory capsules are large and are connected by a small tectum synoticum which is fused with the tectum posterius of the occipital arches. There is a large basicapsular fenestra between the basal plate and auditory capsule and a small strutt of cartilage,—the anterior basicapsular commissure, separates the sphenoid fissure from the anterior basicapsular fenestra. The glossopharyngeal nerve passes through an independent foramen which could be regarded as the remnant, corresponding to the posterior basicapsular fenestra of *Salmo* (de Beer, 1937). The vagus nerve passes separately through a metotic fissure between the occipital arch and auditory capsule.

In the visceral arch skeleton the quadrate is fused with the hyomandibula which articulates in the region of anterior semicircular canal of auditory capsule and the post-orbital process. The anterior portion of the pterygoid process is separated from the posterior portion by a small gap. All the five branchial arches are developed.

The chondrocranium of *Rila* (12 mm. stage) differs from the chondrocranium of *Mystus* considerably in the ethmoid region. In *Rila* the lamina precerebralis forms the anterior boundary for the cranium and a nasal septum in strict sense is absent. The ophthalmic branch of the trigeminal nerve passes in a groove, whereas in *Mystus* the nerve passes through a foramen in the lamina orbitonasalis. The olfactory foramen is large. The epiphysial bar connecting the orbital cartilages shows a small taenia tecti medialis. The glossopharyngeal and vagus nerves pass through a common fissure—the metotic fissure.

The interrelationships between these members and the other members of siluroids are discussed in the paper.

#### 70. Further observations on the feeding habits of young Carp fry.

K. H. ALIKUNHI, Cuttack.

The young fry of Indian carps have been shown to prefer zooplankton to phytoplankton as food when they start alimentation towards the completion of yolk absorption. Stocking of carp nursery ponds with fry has therefore to be based on the quality and quantity of plankton then available in them. There is, however, hardly any information on the feeding capacity of carp fry that would enable regulation of stocks on the basis of plankton. Ordinarily, heavy stocking of the pond results in rapid depletion of plankton.

A series of laboratory experiments carried out on the feeding capacity of young carp fry under different environmental conditions have shown that :—

(1) they are selective feeders, capable of distinguishing desirable food items from the undesirable ones.

(2) They avidly feed on zooplankton, gorging the stomach within an hour, but for longer durations desist from taking phytoplankton even when no other food is available in the environment.

(3) A fry about 6.57 to 6.91 m.m. long has been observed to have consumed 130 to 143 cladocerans (*Moina*) within 24 hours. The maximum number eaten in an hour was only 32-34 and these probably represent its maximum feeding capacity for the particular periods.

(4) The number of cladocerans consumed by the fry in a given period increases with the increase in concentration of cladocerans in water.

(5) When the density of fry is low and plankton poor or moderate in water the former are probably unable to catch the maximum number they are capable of eating. But when the density of fry is increased plankton is quickly depleted.

(6) Starving the tender fry appears to adversely affect their feeding capacity. Artificial feeding during temporary storage in pits or *hapas* is therefore necessary to keep the fry healthy and in good condition.

The above points have been discussed in detail in the light of experimental data furnished.

#### (vi) Amphibia

##### 71. The function of the spiral valve in the heart of the tadpoles of *Rana tigrina*.

RAVI PRAKASH, Bhopal.

A perusal of literature reveals that the majority of investigators believe that there is no selective distribution of blood in poikilothermal animals and that it is the mixed blood which is supplied to all parts of the body. In view of these observations the function of the spiral valve of keeping arterial and venous blood streams separate inside the conus arteriosus of the heart of frogs has been questioned. Serial sections of the heart of the tadpoles of the frog, *Rana tigrina* have been examined under Reichert's Fibroscope and the function of the spiral valve has been ascertained. The bulbus cordis (conus arteriosus) arises as a distinct chamber from the right side of the cephalic portion of the ventricle. From the bulbus cordis the truncus arteriosus extends cephalad. The bulbus cordis is traversed along its entire length by the spiral valve. It has been observed that the fibres present in the wall of the bulbus cordis, in the spiral valve and in the wall of the truncus arteriosus have the same histological structure and all form a continuum. Such a continuity in the muscular components of the bulbus cordis and the truncus arteriosus through the spiral valve indicates that a continuous muscular pathway exists in the heart of the tadpoles of the frog to transmit the contraction impulses from the bulbus cordis to the truncus arteriosus. The spiral valve therefore, has been regarded as an important constituent of the impulse conducting system of the heart of the tadpoles of *Rana tigrina* for conveying the contraction stimulus from the bulbus cordis to the truncus arteriosus.

##### 72. Observations on the brain of *Gegenophis* Species (Apoda, Amphibia).

V. VIJAYAPRASANTHAN PILLAY, Trivandrum.

A description of the various parts of the brain of *Gegenophis* Sp. is given. The most important peculiarities of the brain of *Gegenophis* Sp. namely the enormous development of the cerebral hemispheres, reduced optic lobes and the location of the pars nervosa at the extreme tip of the hypophysis and its connection with a nerve fiber tract etc. are described. A description of the ventricles of the brain is given. Location of the pre-optic nucleus containing the neuro-secretory cells of the brain, and the transport of their products through the pre-optico-hypophyseal tract to the pars nervosa of the pituitary body, is described.

##### 73. A note on the abnormal heart of *Rana hexadactyla*

T. S. PILLAI, Bangalore.

The abnormal heart of *Rana hexadactyla*, herewith described seems worthy of notice. The animal, apparently in good condition, showed a pulsating mass, while dissecting, at the right side of the throat. It was found to be the ventricular end of the heart lying quite outside the region of protection afforded by the pectoral girdle. The apex of the ventricle was directed forwards and to the right, while the conus arteriosus extended backwards to open into the truncus arteriosus, but

the aortic arches were normally disposed. The remarkably long and tubular atrium lying in front of the sinus opened forwards from behind into the ventricle. The entire heart was covered by the pericardial membrane though it was partially attached to the subjacent tissues at the ventricular region. Much of the interest centres round the atrium which showed a septum that was horizontal instead of being sagittal. The common pulmonary vein opened into the atrium midventrally very close to the sinus-atrial opening with no septum separating them. The dorsal mesocardium was entirely absent although its presence was reported by Watt (1915) in the straight heart of an adult frog.

The causes that led on to the malformation are partly embryonic and partly mechanical. During development the cardiac tube did not form the spiral twist characteristic especially of the higher vertebrates (Keith 1921). Hence the atrium has retained its primitive embryonic condition of remaining in front of the sinus venosus and behind the ventricle. Situated thus, the abnormal growth in length has resulted in the version of the ventricle through  $180^\circ$  in a sagittal plane around a transverse horizontal axis and caused the apex of the ventricle to be directed forwards and the conus backwards. The heart in addition has rotated through  $90^\circ$  around the axis passing between the sinus and truncus, and the conjoint effects of the two versions have resulted in the ventricle being directed forward and to the right. This can be appreciated only when it is realised that the conus arises from the right ventral side of the ventricle in the normal heart. Thus one type of abnormality has led on to another.

#### 74. The development of the apodan vertebral column.

L. S. RAMASWAMI, Bangalore.

The development of the vertebral column has been studied in the apodan *Ichthyophis glutinosus* L., and also in a few stages of *Gegenophis*. The only other record of the development is by Marcus and Blume (1926) on *Hypogeophis*, whose observations are interpreted in a different way by Stadtmüller (1936). In *Ichthyophis* there is a penetration of sclerocytes from the arcual region into the notochord for the formation of intravertebral cartilage. This is considered to be a primitive feature. The composition of an apodan vertebra follows an unique plan unlike what is noticed in other vertebrates. Generally in vertebrates, the basalia of a segment unite with the interdorsal and interventrals of the next succeeding segment to form a vertebra but in Apoda the basalia unite with the interdorsal of the next segment (which is normal) and also with its own interventral (which is abnormal). According to Stadtmüller (1936) the basalia unite with its own interdorsals (which is abnormal) and with the interventrals of the next segment, which is normal). I am able to confirm Marcus and Blume's observations. The basiventral and interventral unite to form the so called processus anterior inferior of the apodan vertebra. The basidorsal arches, the supradorsal, the zygapophyses and the processus anterior inferior are the only cartilaginous parts of the vertebra. The centrum and the remaining parts of the neural arch are membranous in origin.

#### (vii) Reptiles

#### 75. On the myology, blood vascular and nervous supply of cloaca and hemipenes in *Uromastix hardwickii* Gray.

TRILOK MAJUPURIA, Aligarh.

The present paper deals with a brief account of the muscles, blood vessels and nerves of the cloaca and copulatory organs of the lizard, *Uromastix hardwickii*.

Ventro-lateral muscles arise from Proc.-traversii, while ventral muscles arise from Proc. spinal ventrales of the caudal vertebra. Muscles are inserted by tendons on posterior margin of osseum ischii forming pars ischio-candalis. These are paired and are distinguished as the retractor, the relevator, and the dilator. M. Caudo-iliofemoralis forms a tubular continuation under the ischiatic caudalis. M. retractor penis serves for lodging the hemipenis with cloacal continuation. M. vaginalis penis is found in coherence with the skin over penis. M. retractor cloacalis medialis, M. ischio caudalis, M. sphinctor cloacalis, M. relevator cloacalis anterior, M. relevator cloacalis posterior, M. Relevator Medialis and M. Relevator cloacalis lateralis are the cloacal muscles of the lizard. Arterial supply of the region is mainly due to dichotomous branches of Art. iliaca interna. Art. cloacalis, supplies the proctodaeum and the urodaeum while Art. penis maintains blood supply to the hemipenis. Venous blood from cloaca and rectum is collected by cloacal and rectal veins opening into afferent renal. Internal iliac is responsible for venous supply in hemipenis. Nervous supply to the musculature of cloaca and hemipenis is by (a) N. dilator lateralis, (b) N. proctodaei, (c) N. Penis, (d) N. retractor medialis.

#### 76. The respiratory System of *Uromastix hardwickii* Gray.

BHUPINDER NATH SUD and KRISHAN LAL KHERRA, Hoshiarpur.

The respiratory system of *Uromastix hardwickii* Gray is composed of a pair of lungs and a series of air passages—the nasal cavities, the mouth cavity including the pharynx, the larynx, the trachea and the bronchi—which convey air to them. The cavity of the lung is continuous. The internal surface of the lung shows trellis-like net work of ridges, separating the alveoli from each other. The anterior portion of the lung is thicker than the posterior. The lung is lined on the outside by a serous membrane and on the inside project inter-alveolar ridges between the alveoli. The alveoli and the inter-alveolar ridges are lined with endothelial cells. The wall of the bronchi and the trachea are supported by complete cartilaginous rings. A few of the rings bifurcate. The bronchi do not form bronchioles. In the larynx there are two arytenoid and a single cricoid cartilages. Musculus compressor laryngis and musculus dilator laryngis are well developed. The vocal cords are absent. The respiration is accompanied by the harmonious and rapid movements of the thorax and the thorax. The hyoid apparatus is composed of the basihyoid with well developed entoglossus, the basibranchials and the anterior and posterior cornua. The two limbs of the anterior cornua are connected by a ligament.

#### 77. Urinary excretion in the Indian wall lizard *Hemidactylus flaviviridis* (Ruppell).

CHAMPAKA SESHADRI, Delhi.

In most vertebrates urine is passed out in a liquid state, but in birds it is semi-solid and an extreme case of solid urine is observed in the common wall lizard *Hemidactylus flaviviridis*. This is a water balance and water economy device in view of the markedly dry climate in which this lizard is found in abundance. The unique method of water conservation employed by the lizard is the extraction of water from the urine before it is evacuated. The morphology and histology of the parts concerned in the urine dehydration are described in detail in this paper. The chemical composition of urine seems quite favourable for the

reabsorption of water. It consists of sparingly soluble uric acid and allantoin. One could surmise how the uric acid and allantoin are kept in solution in the early stages of urine excretion; the urine may be slightly alkaine in the kidneys and the ureters by which the two components are kept in solution. When the medium becomes acidic in the coprodæum, these substances are crystallised out. The water left over after crystallisation is absorbed by columnar absorptive cells of the villi in the coprodæum, and the solid urinary pellet is shaped in this chamber. Mucous glands present in the region of the proctodæum lubricate the faeces and the urinary pellet, for easy passage to the outside.

#### 78. Scalation of *Uromastix hardwickii* Gray.

BHUPINDER NATH SUD and J. K. KHITH, Hoshiarpur.

In *Uromastix hardwickii* Gray a scale or a group of scales shows fairly constant number, form and arrangement and thus it is possible to give a precise description of the scales of this species. HEAD AND NECK SCALES: Rostral—azygous, hexagonal; Postrostrals—4 to 7; Internasals—3 to 4; Supranasals—2 to 3, squarish or pentagonal; Cantlials—2 to 3, pentagonal or hexagonal; Frontonasals—variable; Interorbitals—pentagonal or hexagonal; Interparietal—azygous, pentagonal, parietal 'eye' visible; Parietals—variable; Occipitals—anterior squarish or pentagonal and posterior granular; Supraoculars—numerous; Superciliaries—variable; Circumorbitals—variable; Dorsal Nuchals—granular, subequal; Prenasals—1 to 3, squarish or pentagonal; Nasal—irregularly shaped; Postnasals—1 to 3, squarish or pentagonal; Subnasals—2 to 3; Loreals—3 to 4; Lorilabials—6 to 9; Preoculars—3 to 4, squarish or pentagonal; Suboculars—7 to 9, second from posterior end enlarged; Postoculars—6 to 8; Ciliaries—double row on each eyelid, rectangular; Palpebrals—granular; Supralabials—10 to 14; Temporals—variable; Auricular lobules—3 to 9, feebly denticulate; Lateral Nuchals—granular; Mental—azygous, pentagonal or hexagonal; Postmentals—3, pentagonal or hexagonal; Infralabials—13 to 17, pentagonal, posterior very small; Sublabials—longitudinal rows except posterior most; Chinshields—elongated, pentagonal or hexagonal; Postgenials—mostly pentagonal or hexagonal; Gulars—granular; Ventral Nuchals—granular. BODY AND TAIL SCALES: Dorsals—granular, subequal; Ventrals—smooth, squarish or pentagonal, transverse rows, imbricate; Preanals—granular; Dorsal Caudals—large spinose scales in 31 to 33 cross series separated from one and other by 1 to 6 rows of small granular and large uncarinate scales, spinose scales juxtaposed and 18 to 23 in a cross series at maximum width of tail; Subcaudals—transverse rows, smooth or carinate. SCALES OF THE LIMBS: Suprabrachials—large, oblique rows, towards elbow small and irregular; Infrabrachials—granular; Prebrachials—rhombic and granular; Postbrachials—granular; Supra antibrachials, squarish or pentagonal, oblique rows, towards elbow granular and irregular; Infra antibrachials—granular; Preantibrachials—variable; Postantibrachials—variable; Supracarpals—rhombic or squarish, imbricate; Infracarpals—variable; Suprafemorals—anterior half rhombic or pentagonal and posterior half granular and spinose; Infracemorals—variable shape around 'femoro-pre-anal pores', anterior to latter rhombic or rectangular and posterior to latter granular; Prefemorals—rhombic or squarish, slightly imbricate; Postfemorals—granular; Supratibials—granular and spinose; Infratibials—oblique rows, imbricate; Pretibials—uncarinate rhombic, imbricate, oblique rows; Supratarsals—variable; Infratarsals—squarish or pentagonal, uncarinate; Supradigital lamellae—hexagonal, single row on each digit, slightly imbricate; Subdigital lamellae—hexagonal, carinate, single row under each digit; Pre and postdigital lamellae—rhombic.

**79. The skull of *Crocodilus palustris* Lesson.**

P. N. MATHUR, Ajmer.

The present investigation comprises a morphological study of the skull of *Crocodilus palustris* Lesson. The skull is monimostylic, akinetic, and diapsidan. The occipital constituents are distinct. The occipital condyle is formed solely by the basioccipital; the exoccipital lamellae support it laterally but do not participate in its formation. The parietals and frontals are united. The orbitotemporal vacuity is divided into two parts, the orbit and the infratemporal fossa. The supratemporal fossa is small and closed while the post temporal fossa is absent. The lateral temporal vacuity is open behind exposing part of the quadrate. The lacrimal is perforated. The nasals reach the premaxillae and the nasal septum is a prolongation of the partly cartilaginous and partly membranous interorbital septum. The choanae lie far back at the base of the skull. The maxillae, palatines and pterygoids unite to form a secondary palate. The prevomers lie hidden underneath the secondary palate. The vomero-nasal openings or Jacobson's foramina are absent. The snout is elongated due to extension of the maxillae. The upper jaw bears 16-19 thecodont teeth out of which 5 belong to the premaxilla. The premaxillo-maxillary suture is transverse. The processus nasalis of the premaxillae separates the nasals.

Each mandibular ramus is composed of 6 pneumatic bones beset with 15 thecodont teeth. The splenial also contributes to the formation of the symphysis. The processus retroarticularis articulates with the elevated expansion of the pterygoid.

The characters indicate a progress in evolution in relation to other reptiles and point to Dinosaurian affinities but do not entirely support the descent of Crocodiles from the latter.

**80. The arteria laryngo-trachealis of *Calotes versicolor* (Daud).**

T. S. PILLAI, Bangalore.

The statement of Von Benndorff (1881) that the arteria laryngo-trachealis can always be seen in Lacertilia is increasingly being recognised by various authors. In *Calotes versicolor*, as in other forms, the artery arises from each pulmonary artery somewhat beyond its origin from the pulmonary trunk. The two arteries thus formed run forwards lying one on either side of the trachea in close association with the respective vena lateralis. The left arteria laryngo-trachealis is considerably larger than the right extending to the larynx, giving rise to arteries, along its course, to the trachea and larynx and series of larger ones branching profusely to both sides of the oesophageal, pharyngeal and buccal regions where they end in capillaries.

The extensive vascular supply to the pharyngeal and buccal regions from the arteria laryngo-trachealis clearly indicates the existence to a certain extent at least, of a bucco-pharyngeal respiration in *Calotes*. A vessel similar to the one mentioned and having the same relationship to the pulmonary artery occurs in some of the Ophidia. This branch of the pulmonary artery supplies blood to the so-called 'tracheal lung' of the snake which subserves a respiratory function (Bellairs' and Underwood, 1950). From what is mentioned one cannot but feel that the arteria laryngo-trachealis of Lacertilia and the branch of the pulmonary artery proceeding to the 'tracheal lung' of the Ophidia are homologous structures, and one of the original functions was the transmission of blood to special organs of respiration. It is then difficult to resist the conclusion that the presence of the arteria laryngo-trachealis, though showing varying degrees of degeneration or even loss, as in most of the snakes, is not merely a lacertilian but also a lepidosaurian feature as snakes themselves have descended from a lacertilian ancestor.

**81. The development of the vertebral column in *Calotes versicolor* (Daud).**

K. M. KADAM, Bangalore.

The development of the vertebral column in *Calotes* has been studied from a very early stage (3 mm.) through a series of successive stages upto the almost adult condition. The notochord is cylindrical in the early stages being surrounded by a thin notochordal sheath. It becomes differentiated into a moniliform structure by constrictions and dilatations in the intersclerotomic and intrasclerotomic regions respectively. The perichordal rings develop surrounding the dilated parts of the notochord from the proliferations of the sclerotomes. The perichordal rings become connected by mesenchymatous tissue to form a continuous perichordal tube. It becomes segmented into a series of vertebral segments.

In the early stages intrasclerotomic fissure is noticed separating the cranial and caudal halves of each sclerotome. The anterior half of each perichordal ring is surrounded on both sides by the cranial half of a sclerotome while its posterior half is surrounded by the caudal half of the sclerotome in front of it. The basidorsals are connected by a supradorsal cartilage forming a complete neural arch. In front of and behind the cartilaginous basidorsal arch there are connective tissue arches which ossify without passing through a cartilaginous stage. The dorsointervertebrals become divided into pre and postzygapophyses by the extension of a strand of connective tissue cells. In the caudal region the basiventrals are connected by an intraventral completing the haemal arch. There is no fibrous layer or any other weak spot in the centrum of the caudal vertebrae.

There is no trace of the capitulum even in early stages. The rib articulates with only one head with the diapophysis of the centrum. There is a neurocentral suture near the base of the basidorsal. The centra of both the atlas and axis vertebrae are formed in a typical manner. The pleurocentrum of the proatlas is fused with the anterior end of the odontoid process which does not ossify. The proatlas is formed from the half segment left over during the secondary segmentation, between the first cervical vertebra and the occipital region of the cranium. A separate notochordal dilatation is noticed in this region. Only in the first six cervical vertebrae basiventrals are present and these arise as unpaired elements at the anteroventral ends of the vertebrae.

**(viii) Mammals****82. Extinct and vanishing mammals from the desert of Rajasthan and the problem of their preservation.**

ISHWAR PRAKASH, Jaipur.

Descriptions of Jerdon (1967, *Mammals of India*), Blandford (1888-91, *F.B.I.*) and Adams (1899, *Western Rajputana States*) show that some of the mammals were most abundant in the desert region. However, during a study of the vertebrates of this region, it has been found that many of these species were either exterminated or were on the verge of extinction. The Black Buck, *Antelope cervicapra rajputanae*; the leopard, *Panthera pardus* and the Indian wolf, *Canis lupus pallipes* have considerably reduced in number. Others, such as the long-eared hedgehog, *Hemiechinus auritus collaris*; the Indian flying fox, *Pteropus g. giganteus*; the Caracal, *Caracal caracal* and the Indian desert gerbille, *Meriones hurrianae* have also suffered a great decrease in their population. The paper deals with the probable causes of this reduction during the past hundred years. It is suggested that the



following places may be declared as Game Reserve or Sanctuaries and the animals noted against them may be preserved there in.

Sardar-Samand, Jodhpur—Black Buck, Gazelle, Nilgai, Wild-boar. Chital and Sambhar may be introduced.

Gajner, Bikaner—Gazelle, Black Buck, Wild-boar. Sambhar may be introduced.

### 83. Hypertrophy of the bullae tympanicae in the desert mammals.

ISHWAR PRAKASH, Jaipur.

Heim de Blasac (1938) first analysed the phenomenon of hypertrophy of the bullae tympanicae in the desert mammals. Bodenheimer (1953) states that about 80% mammals from the west of the Sahara desert showed a definite hypertrophy of the bullae. Similar facts are known about the desert animals of Central Asia and America. However, no information is available about the mammals of the Indian desert.

During a study of the vertebrates of the desert of Rajasthan (a project aided by U.N.E.S.C.O.), cranial measurements of desert forms were compared with those of corresponding non-desert types. This comparison revealed that the auditory length of the desert mammals was above 30% of the condylobasal length. The length and breadth of the tympanic bullae were above 22% and 16% of the condylobasal length respectively. However, in the mammals from the non-desert region these values were considerably low.

### 84. Studies on the biometry and habits of Bombay rats.

P. J. DEORAS and M. S. GOKHALA, Bombay.

These studies pertain to the different measurements done on 2184 rats, which included 1004 males and 1180 females. The rats were picked up from the collections brought to this Institute each *Bandicoota bengalensis*, *Bandicoota malabarica*, *Mus musculus*, and *Suncus caeruleus*.

The measurements were limited to the length of the body, neck, head, ears, and tail. They also included the rings on the tail, the number of mammae, the number of vibrissae, shape and size of the pellets, and the weight of the body. The shape of different rat burrows and their preening habits were also investigated.

The statistical analysis of the data gives figures which could be used in the identification of these rats.

### (ix) Comparative Physiology

### 85. Comparative study of the water and total solid content in the skeletal muscles of some vertebrates.

K. M. ALEXANDER, Delhi.

The amount of water and total solids in the skeletal muscles of twenty representative vertebrates was studied. A general survey of the results obtained in the present investigation reveals, that there is a gradual and progressive concentration of the muscle protoplasm along the phylogenetic series, from the freshwater fishes to birds and mammals.

The marine fishes show a greater proportion of total solids than the freshwater fishes and amphibians. The avian and mammalian muscles exhibit the greatest reduction in the amount of water and increase in the amount of total



solids, thereby indicating, the greater metabolic activity and muscular efficiency of these animals. As regards the representatives of each class, observations indicate possibility of variations within the group. While the variations met with in the fishes seem to be traceable more to differences in their habitats, those observed in birds can be accounted for, only on the grounds of their habits.

### (x) Cytology

#### 86. Cytology of three species of Coreid Bugs with special reference to multiple sex chromosome mechanism.

M. K. DUTT, Delhi.

The paper deals with a study of chromosomes in three species of heteroptera, viz., *Homoeocerus (Omanocoris) variabilis* (Dallas), *Cletus pugnator* (F.), belonging to subfamily Coreinae and *Leptocorixa varicornis* (F.), belonging to Alydinae. The diploid number of chromosomes in the three species has been found to be 21, 18 and 17 respectively. The oögonial metaphase plates of *Cletus* show 20 chromosomes. The chromosomes could not be classified according to size in any of the species. Metaphase plates of *Cletus* are, however, characterized by a very large pair of chromosomes. As usual with the coreids, a pair of 'm' chromosomes are present in all the three species. The sex chromosome appears to be one of the medium sized ones in all. The sex determining mechanism in *Homoeocerus* and *Leptocorixa* has been found to be XO in the male while in *Cletus* it is  $X_1X_2O$  ♂ :  $X_1X_1X_2X_2$  ♀. The problem of the type number in the subfamily Coreinae and the behaviour of compound sex chromosomes have been discussed in the paper.

#### 87. Cytology of the male germ cells of *Hemidactylus flaviviridis* Rüppell as studied by the Phase-Contrast Microscopy.

BHUPINDER NATH SUD, Hoshiarpur.

In this paper the morphology and the fate of the cytoplasmic inclusions of the male germ cells of *Hemidactylus flaviviridis* Rüppell have been studied in the living material under the phase-contrast microscope. The Golgi material in the spermatocyte stages is in the form of haphazardly arranged granules, giving a high phase-change. In the early spermatid stages the Golgi granules form a juxta-nuclear mass in which a few very small hyaline vacuoles appear. Ultimately the entire mass of Golgi granules is transformed into a single large hyaline vacuole, the proacrosome. The proacrosome pushes the nuclear membrane downwards and during this process an acrosomal granule is differentiated in the proacrosome. The proacrosome along with the acrosomal granule is finally converted into a conical acrosome, applied to the anterior aspect of the elongating spermatid nucleus. The mitochondria in the spermatocyte stages are in the form of long filaments, giving a lower phase-change than the Golgi granules. In early stages of spermatogenesis the mitochondrial filaments break up into granules. Ultimately some of the mitochondrial granules are sloughed off and the rest form the sheath of the middlepiece which is bounded in front and behind by the proximal and the distal centriole and laterally by the fused manchette and plasma membrane. The enigmatic chromatoid body gives a very low phase-change. It appears and disappears without any apparent function. The ripe sperm consists of a long, curved nucleus, carrying a small conical acrosome at its anterior end and a small middle-piece followed by a long tail at the posterior end.

**88. Studies on the chromosomes of spiders *Pardosa lahorensis*, *Hippasa aglenoides* (Lycosidae) and *Selenops radiatus* (Selenopidae).**

G. P. SHARMA and SOHAN SINGH, Hoshiarpur.

The male chromosome complements of *P. lahorensis*, *H. aglenoides* and *S. radiatus* consist of thirteen, eleven and thirteen pairs of autosomes with a XXO, XXO and XXXO-type of sex mechanisms respectively. The chromosomes in all the three species are acrocentric. The sex chromosomes are rod-shaped and the two and three Xs in *P. lahorensis* and *S. radiatus* are of equal lengths while the two Xs are unequal in *H. aglenoides*. This size difference of the X chromosomes is quite evident during the leptotene and the metaphase I when they are positively differentiated from the autosomes as separate bodies. The general course of meiosis in all the three species is typical except the presence of a well marked diffused stage inbetween the zygotene and the pachytene in *S. radiatus*. The first division is reductional and the second equational for both the sex chromosomes and the autosomes. The sex chromosomes are positively heteropycnotic throughout the mitosis and meiosis in *S. radiatus* while in the remaining two lycosid spiders these show this differential behaviour only during meiosis. The preceding of the sex chromosomes in the first division is true of all the three species.

**89. Studies on the chromosome complement and male meiosis in three species of the 'Jumping Spiders' (*Plexippus*: Salticidae).**

G. P. SHARMA and H. D. SHARMA, Hoshiarpur.

The chromosome complement of *Plexippus paykulli*, *Plexippus* sp. (No. 1) and *Plexippus* sp. (No. 2) consists of 13 pairs of autosomes and the  $X_1X_2O$ -type of sex mechanism in each case. The autosomes as well as the sex chromosomes are strictly acrocentric. The sex chromosomes are indistinguishable from the autosomes during all the spermatogonial stages and can be identified for the first time, as heteropycnotic bodies in the premeiotic resting stage. The sex chromosomes assume different configurations during the pre-synaptic and the post-synaptic stages of the first meiotic division and maintain their identity as heteropycnotic bodies even in the spermatids. The general course of meiosis in all the three species is typical. The spiral structure of the autosomes like that in most of the insects during prophase II is, however, a marked feature in *P. paykulli* and *Plexippus* sp. (No. 2). The first division is reductional both for the autosomes and the sex chromosomes. The sex chromosomes form an accessory plate during metaphase I and precede the autosomes during the following anaphase. The second division is equational for the autosomes as well as the sex chromosomes.

**90. Sex chromosomes and the male meiosis in *Lizardasp.* (Reduviidae-Heteroptera).**

RAM PARSHAD, Hoshiarpur.

The male sex mechanism in *Lizarda* sp. is  $X_1X_2Y$ . Of these three sex chromosomes two ( $X_1$  and  $Y$ ) are the smallest and equal in size while the third ( $X_2$ ) is morphologically indistinguishable from the autosomes. This size relation of the three sex chromosomes is quite evident from diakinesis onwards and is a marked feature of metaphase II when the three elements form a pseudotrivalent.

The diploid number of chromosomes in this species is 23. The general course of meiosis is typically heteropteran so that the autosomes divide reductionally and the sex chromosomes equationally during meiosis I, while during meiosis II the

autosomes divide equationally and the sex chromosomes reductionally. Consequently fifty percent of the sperms produced carry  $X_1$  and  $X_2$  while the remaining fifty percent carry only Y.

**91. The chromosome complement and meiosis in *Antilochus conqueberti* Fabr. and *Scantius volucris* Gerstaeck (Pyrrhocoridae-Heteroptera).**

RAM PARSHAD, Hoshiarpur.

The diploid number of chromosomes in the males of *Antilochus conqueberti* and *Scantius volucris* is 27 and 19 respectively. The number of chromosomes in *A. conqueberti* is the highest so far recorded for any species of this family. The male sex mechanism in both the species is XO-type, the X chromosome in *A. conqueberti* being the largest element, quite well marked in the gonial complement.

The general course of meiosis is typically heteropteran in *A. conqueberti* while in *S. volucris* it is peculiar in that the primary spermatocyte after the contraction stage directly enters the diffused stage so that the regular zygotene and the pachytene are altogether absent in this species. The sex chromosomes, in both the species, divide equationally during the first maturation division while during the second it is included in only one of the spermatids so that fifty percent of the sperms, thus produced, are with the X element while the remaining fifty percent are without it.

**92. Studies on the chromosomes of the Spiders, *Oxyopes ryvesii* and *Oxyopes* sp. (Oxyopidae).**

G. P. SHARMA and K. K. TANDON, Hoshiarpur.

The chromosome complements of *Oxyopes ryvesii* and *Oxyopes* sp. consist of ten pairs of autosomes and XO-type of sex mechanism in each case. Both the sex chromosome and the autosomes are acrocentric in nature. Usually only a single chiasma is present in each bivalent, but some bivalents with two chiasmata have also been seen. The sex chromosome assumes different configurations at leptotene stage and maintains its identity even in the spermatids as a heteropycnotic mass. A diffused stage in between the pachytene and the diplotene has also been observed in each case. The first division is reductional and the second equational for both the autosomes and the sex chromosome.

**93. Studies on the chromosomes of the Spider, *Leucauge decorata* (Argiopidae).**

G. P. SHARMA and K. K. TANDON, Hoshiarpur.

The chromosome complement of *Leucauge decorata* consists of eleven pairs of autosomes and XXXO-type of sex mechanism. The chromosomes are thin and appear to be acrocentric. Out of the three X's, one X is bigger than the remaining two which are almost of the same size. They are heteropycnotic and maintain their identity even in the spermatids where they are seen as a single heteropycnotic body. The bivalents have either a single chiasma or two.

The first division is reductional and the second equational for both the autosomes and the sex chromosomes.

The presence of three X's has been recorded for the first time in this family.

**94. Studies on the chromosome behaviour in three genera of Indian Homoptera.**

P. S. MENON, Delhi.

The paper deals with the meiotic behaviour of chromosomes in three different genera of Homoptera, viz., *Oxyrhachis* sp., *Olinotus* sp. and *Gargara* sp., all belonging to the subfamily Centrotinae of the family Mebracidae. Two genera *Oxyrhachis* and *Olinotus* are seen to possess the same diploid number of 21 chromosomes while *Gargara* shows 19 chromosomes in the spermatogonial complement. It has been observed that between the three different genera there is noticeable variation in the sizes of the chromosomes although a classification based on the size difference was not possible in any of the genera. In the case of *Gargara* a pair of large chromosomes is, however, noticed. The X chromosome appears to be one of the medium sized ones in all the genera. The general course of meiosis follows the same pattern showing the XO-type of sex determining mechanism. The first division is reductional and the second division is equational for the sex chromosome. The present investigation has added two more genera with the same diploid number of 21 to the already known eight species showing the same number (Makino 1951 and Rao 1956). Until more genera of Membracidae are worked out, it may be tentatively assumed that the type number for this family is 21.

**95. Mitotic sequence in the mesonephric cells of early Chick Embryos and its relation to basophilia and alkaline phosphatase reactions.**

SAMARENDRA MITRA and SIVATOSH MOOKERJEE, Calcutta.

The study deals with the rate and site of mitosis in the formation of mesonephros and their relation to basophilia and alkaline phosphatase reactions, in early chick embryos. In 3 days Embryo, mitotic counts have been made in the different developmental areas of pro-meso-metanephros. In the pronephros region, cell-counts reveal no incidence of mitosis, except for a few stray cases observed. The alkaline phosphatase and the basophilic reactions in this area present a weak localisation pattern. In the mesonephros area, innumerable mitosis take place. The incidence of cell division seems to be higher in the middle region of the mesonephros. The site of mitosis is restricted generally at the inner side of nephrogenic tubules and the duct. The alkaline phosphatase and basophilic test show the cells of the lumen portion, where active mitoses are taking place, are also sites for intense reactions. The cells of the outer side of the duct and the tubules, devoid of any active occurrence of mitoses, are also the area of the less reaction of alkaline phosphatase and basophilia. In the metanephros area, the cells lie in a dormant way and no marked evidence of mitosis is observed. This happens also to be an area for less cytochemical reactions. In the embryos of 4, 5 and 6 days, the mesonephros cells consolidate and undergo progressive development and also become more intense in alkaline phosphatase and basophilic reactions. The importance of time and place of mitosis is discussed in relation to mesonephros differentiation.

**96. Cytochemistry of X-ray action in Chick Embryo.**

SIVATOSH MOOKERJEE and ASOKE BOSE, Calcutta.

The effects of radiation on the localisation pattern of 5 cell substances viz., alkaline phosphatase, basophilia, nucleic acids, mucoprotein, and glycogen have been investigated in chick embryos. The chick embryos are exposed to the effects of X-rays at the dose range between 300r to 2000r and are analysed after 24 and

48 hours of incubation. In all experiments following radiations (except for glycogen—which remains more or less constant) there are indications of an initial fall of the substance localisation pattern. Such effects are verifiable after 24 hours. However, the cell substances seem to compensate again almost to the level of normalcy as observed in the embryonic cells after an incubation of 48 hours. The embryos radiated at 1000r, exhibit a tendency of a sudden increase in the localisation pattern of all substances tested, the concentration of the substance localisations show however, a general fall off with the increase of dosage beyond 1000r. The effects of 2000r are in the total failure of organisation marked by the very feeble localisation of the substance pattern. The implication of weakening of substance reaction to failure of induction have been discussed.

**97. Cytochemical analysis of the effects produced by the action of delayed incubation in Chick Embryo.**

ASOKI BOSE, Jhargram.

A cytochemical analysis of an unusual ontogenesis, resulting by the action of delayed incubation in chick embryo has been worked out. Localisation patterns of the D.N.A., alkaline phosphatase and basophilia have been followed up in embryo, experimentally deterred incubation at different days by temperature fasting. More or less normal development results in the eggs undergone fasting of temperature for 7 days after laying. The cytochemical picture of embryonic cells shows normal reactions. With the increase of the temperature-fasting period, progressively the Feulgen, alkaline phosphatase and basophilic localisations tend to present weak reaction in the cells. It is significant that the delayed embryo of 10 days appears also to be defective in its organisation pattern. The neural tube and notochord-somite show less cytochemical reactions and are also sites of developmental inhibition. The reaction of these three cell substances appear to be almost negative in the cells of the embryo, which has undergone a delay for 20 or more days before incubation. In such embryo there has been a complete failure of induction, and the blastoderm is a sheet of undifferentiated cells with definite signs of depletion of their cell substances.

## **SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY**

*President :—*DR. M. N. SRINIVAS, Ph.D., D.Phil.

### *Abstracts*

#### **I. PHYSICAL ANTHROPOLOGY**

##### **1. Palmar dermatoglyphics of the Juangs of Orissa.**

MANISH CHAKRAVARTTI, Calcutta.

146 palm prints of 60 males and 16 female Juangs were collected during the months of February-March 1956. These were mainly collected from Dhenkanal district in Orissa.

The present paper deals with the frequency and distribution of the main line formula; axial triradii and on the thenar, hypothenar areas and between the interdigitals.

##### **2. Finger Prints from Orissa Aborigines.**

S .S. SARKAR and A. R. BANERJEE, Calcutta.

During February-March, 1956 finger prints were collected from among the following aborigines in Orissa : Juang (male—74, female—17) ; Sabara (male—54, female—9) ; Khond—16; Pano—15; Santal—11; Gond—9; Munda—6; Pauri Bhuiya—6; Townra—3 and Kisan—3. The data were largely collected from the districts of Dhenkanal, Pal Lahara and Keonjhar. A detailed analysis of the various types of finger print patterns has been made in the present paper.

##### **3. The Kabui Naga.**

T. C. RAY CHAUDHURI, Calcutta.

In this paper an attempt has been made to decipher the racial history of the Kabuis, one of the Naga tribes of Manipur. On the basis of a number of somatometric measurements and somatoscopic observations on 100 individuals, they are found to be short, mesocephalic, hypsicephalic, mesoprosopic, leptorrhine and meso-opic with straight black hair, scanty beard and moustache, brown skin colour, brown eye colour, occasionally oblique eye, straight nose and moderately prominent zygomatic arch. From a further analysis of the somatic data it appears that short-medium-mesocephalic-leptorrhine, short-medium-dolichocephalic-leptorrhine, and short-medium-mesocephalic-mesorrhine are the main constituent elements with a strong dose of Mongoloid element, as proved by the somatoscopic observations.

#### **II. CULTURAL ANTHROPOLOGY**

##### **Culture change**

##### **4. Rieng culture and historical changes.**

BHABANANDA MUKHERJEE, Calcutta.

The Rieng, originally one of the four clans of the Tipperah, migrated to Tripura round about the 15th century. They were endogamous and marriage with parallel

cousins was the rule. Joint family system was the basis of their social organisation. It is observed at present that there are two fraternal clans, from each of which a number of lineages developed and two concepts of kinship—*sandai* (close kin) and *hochu* (distant kin) determine the kinship. Cross-cousin marriages are now in vogue. In Tripura, the Riang passed through five major periods during which changes in their culture occurred. The economic, political and religious organisations have been affected. Changes in the economic organisation have enlarged the field of social participation. The political organisation was modified in the beginning of contact with the ruling community of the state and became completely disorganized later on due to factions. Contact with Hindu refugees led them to worship Hindu deities and adopt many ritual objects of the Hindus. The changes being on the superficial level, have not vitally affected the social structure of the Riang.

##### 5. Culture-change among the Onge of Little Andaman.

N. DATTA-MAJUMDAR, Calcutta.

The Onge of Little Andaman Island, a Negrito tribe numbering about 200, depend for their livelihood on hunting, fishing and food-gathering. Cultivation is entirely unknown to Onge culture.

Onge technology is very simple and based on wood, bamboo, cane, bones and shells. A complete inventory of Onge tools, weapons and domestic utensils cover only about 21 items, chief among which are bows, arrows, spears, harpoons, wooden buckets, bamboo tubes, cane baskets, canoes and nautilus shells. Iron is however a recent innovation in Onge culture, but iron metallurgy is unknown to them even now. Though suitable stones are available in the island, the technique of making stone implements has not been discovered by the people. They do not even know the art of producing fire, though they know the use of fire in cooking. Fire is, therefore, carefully preserved by means of smouldering pieces of wood.

As a result of their sporadic contact with the forces of civilization represented by the Andaman Administration, the settlers in South Andaman, and since 1948 the research parties of the Department of Anthropology, Government of India, the Onge have already come to appreciate a number of foreign articles, e.g., tobacco leaves, tea leaves, sugar, matches, iron implements and aluminium utensils. They occasionally get some of these articles by way of present either from the Administration at Port Blair or from the anthropological research parties visiting Little Andaman. But the demand for these articles of foreign origin, and especially for tobacco leaves, has grown so much that they have begun to barter away their valuable honey and shells for these objects.

The cultural changes mentioned above show that the Onge are in a process of transition from a pre-lithic age to the iron age, and from a pre-barter economy to a barter-cum-money economy. These changes, though at present touching only the fringe of Onge culture, have an important significance for Onge society. The Onge who till very recently had an autonomous, self-contained and isolated social system and culture is now slowly but surely becoming a part of a wider and more complex society and civilization.

##### 6. The Muthuvan of Travancore: their cultural heritage.

K. GNANMBAL, Calcutta.

The Muthuvan are classified as one of the groups inhabiting the hill slopes of the High Ranges of T. C. State. Their population numbered about 1,301

according to the Census Report of 1931. In appearance, physical characteristics and dress, they compare closely with the Tamils of the adjoining districts of Madras State.

The Muthuvan claim Tamilnad as their original home. An examination of Tamil literature in regard to the regional, ecological units of ancient Tamilakam was comprised of regions like the *kurinchi*, the land of the hill folk, and *mullai*, the pastoral areas. This strengthens the claim of the Muthuvan as belonging to the Tamil districts. The origin of the name *Muthuvan*, interpreted in the light of Tamil literature is a pointer to the cultural heredity of the group. An interpretative study of the clan-names of the Muthuvan, and their connotations reveal vestiges of an antiquated social structure composed of occupational units.

Rites and rituals are links connecting the forgotten and vestigial elements of a culture. Hence a study of the traditional beliefs implied in the funerary ritual, with the symbolism involved in the chants, mentioning the Mother Earth, Siva and skull also helps in understanding the cultural continuity of the group. The significance of the interpretation given by a Muthuvan *mantravadi* of the cooking of rice on the sixteenth day following a death, is pointedly reminiscent of the *Kala velvi*, thanksgiving orgy of the ancient Tamil kings.

The cultural tenacity of the group is shown by its nomenclature and its celebration of *thal-pongal*, the harvest festival of the Tamilnad, amidst the Malayalee surroundings.

### Religion

#### 7. Double Sex—or Divine Couple?

U. R. EHRENFELS, Madras.

The Khasi concept of God comprises both sexes (*U Blei—Ka Blei*), though the masculine is more commonly stressed. The Garo creator god (*Tatara Rabuga*) is male though a goddess (*Noslú Nopantu*) fashioned the earth on his command.

An analysis of Lyngngam concepts of God has been made which shows the Khasi pattern, though with some stress on the femininity of God (*Ka lawbai*). This is compared to a so far not yet recorded Western Khasi theology from Nongstoin, containing ancestral pairs.

#### 8. Religious ideas of the Lodhas of West Bengal.

PRABODH KUMAR BHOWMICK, Calcutta.

The Lodhas of Midnapore in West Bengal, once treated as a Criminal Tribe, are a tribal people, but their religious practices are closely related to those of the Hindus, which is evidently due to close and prolonged contact with the latter. Even then the divergence between the two sets of religious practices is wide enough to present an interesting case. The author has given a brief record of the peculiarities of the socio-religious beliefs of the Lodhas which, in certain cases, border on bigotry and mystification. As they are educationally and economically an extremely backward people, it is natural that their obsessions in regard to certain social and religious practices are very great. What are these obsessions and where they differ from the other religious groups, specially the Hindus, will be manifest from this short paper. The author has, however, tried to present the interesting features of their behaviour both from the social as well as religious points of view.



### III. SOCIAL ANTHROPOLOGY

#### Social organization

#### 9. On Polyandry.

K. P. CHATTOPADHYAY, Calcutta.

In this paper the writer examines the current views on the occurrence of polyandry in different areas and the factors underlying this custom. In every case the available data is submitted to a careful test to ascertain whether it is true polyandry or cicisbeism. Instances are noted of confusion in the use of terms by noted anthropologists. At the end, his conclusions are noted.

#### 10. Preliminary notes on Rajput Hypergamy in Gujarat.

A. M. SHAH, Baroda.

Rajputs are divided into exogamous clans. A lineage of one clan takes wives from lower lineages of other clans and gives daughters to higher lineages. A lineage cannot give daughters to a lineage from which it takes wives. Though a lineage can take wives from all lower lineages and give daughters to all higher lineages it does not cross a particular range.

Different lineages of a clan have different status in different areas depending upon political status. Rulers of princely states are at the top, landlords in the middle, and peasants at the bottom. Different lineages have different customs according to status. All the members of a lineage follow the same customs irrespective of status differences and command equal respect from all members of a lower lineage. Status differences within a lineage have relevance in selecting a spouse within a particular range. Preference for sororatic marriage strengthens hypergamy.

A century ago the highest clans practised female infanticide because there was no clan above to whom they could give their daughters in marriage. The lowest lineages take wives from the lower caste of Kolis. In the end, Rajput hypergamy is compared with Patidar hypergamy and endogamy.

#### 11. The bachelors' dormitory among the Oraons.

SUBRATA ROY, Calcutta.

The moribund primitive tribal institution, styled as *Jonkh-erpa* (i.e. "Bachelors' Dormitory") among the Oraons of Chota Nagpur has at present completely disappeared from most villages, while in others it has gone underground. In villages around the Ranchi-Johardaga road however, the Jonkherpa openly flourishes even to-day. The *Pel-erpa* i.e. "Spinsters' Dormitory" is now practically a thing of the past.

Jonkherpas may be classified into (i) primitive and (ii) modern types. (i) The primitive dormitory is a long mud-walled, tiled hut, and still persists to retain the offensive indoor urine-pit and phallic post. Village bachelors mostly sleep here at night. At the adjacent *Akhra* or dancing ground, they enjoy evening dances, with village maids.

(ii) The modern dormitory is a brick-built hut, bereft of phallic post and urine-pit. Few bachelors stay here at night. It often serves as a guest house.

Its management is vested in at least three Dhangar-Mahatos and three Kotwars, elected triennially, and collectively called *Mukhtas*. The inmates of Jonkerpan

have few duties towards the village in general. They dine at home, and freely perform their private business. Today the *Jonkherpa* has degenerated into a mere evening-club, where villagers gather to gossip, and perform dances on moonlit nights.

#### 12. Some aspects of the social organisation of the Toto.

B. K. ROY BURMAN, Calcutta.

The Toto is a small tribe consisting of 314 souls living at the border of Bhutan and Jalpaiguri district in West Bengal. The tribe has ceremonial dual divisions of different forms, the most important of which is its division into two moieties Orangbei and Watengbei. During the May festival of the tribe, symbolical marriage between daughter of Orangbei and son of Wantengbei takes place. The former moiety is considered to be superior in status. There are 13 clans, all of whom except one are exogamous. One clan has two intermarrying sub-clans. The different clans occupy different well-defined territories and some clans are said to have arisen by fission of another clan due to shift of residence.

#### Enthography

#### 13. A short note on the Natta community.

PARAMANANDA PRAMANIK, Calcutta.

In Undivided Bengal The Natta community used to live in Saidpur in the District of Rangpur (now in East Pakistan) and was notified as a criminal tribe. Now they live in Halisahar in three settlements near the Halisahar Railway Staff quarters. The author noted that though the Nattas have been living in Bengal for generations, still speak a corrupt form of Hindi, and their women dress themselves in *ghagra* or skirt and in blouse, which is not done by women of the same class in Bengal. They claim to have come from Bihar and have some affinity with the Dosadh caste.

Some of the Natta have been converted into Christianity by Salvation Army, yet this change of religion has had little effect on the status of the persons within the community. In marriage, ties between the Natta of the same religion are preferred, but this is not observed in actual practice. In their social functions only the Pasis, a liquor distilling caste, participate.

With regard to economic life of the Natta, the report by the neighbours and the Police is that even now they live mainly by theft in the railway train, or by illicit distribution of liquor, or some sort of traffic in women. The author has however found some of them employed in Government office and in the Railway or in other occupations. Their home environment and clothes were clean. An innocent disclosure of a 14 years boy proved much of their criminal affinity. Some of them received training in weaving, but there are few who pursue the art. They do not wish to live by the hard work of agriculture. Because of their original criminal notoriety, it is also difficult for them to secure service easily.

#### 14. A short note on the Bauri caste of Hooghly District, West Bengal.

KARTICK SASMAL, Calcutta.

This is a short note on the Bauris of Ramnagar, a village in the district of Hooghly, West Bengal. Bauris of this particular village have migrated from the

districts of Bankura and Birbhum. In this particular village, they have settled down as agricultural labourers and become part and parcel of the greater economy. Their social and economic condition, and magico-religious ideas have been dealt with in the present paper.

### Crime and Law

#### 15. Patterns of In-Law Tension among different castes of Dobhi Taluqa (U.P.).

U. GUHA, Calcutta.

The study was carried out in Dobhi taluqa of Jaunpur district, Uttar Pradesh in 1952-53. The object of the study was to find out if there was in-law tension among the various castes of Dhobi taluqa and if so to what extent the patterns of tension differed in different castes.

In this paper only (i) the mother-in-law and the daughter-in-law tension and (ii) the sisters-in-law tension have been dealt with. The informants were selected from the following castes : Brahmin, the Chhatri and the Kayastha (referred to as the Group I); the Ahir, the Nuniya and the Kallar (referred to as the Group II) and the Chamar (referred to as the Group III). Information was collected from 121 families. A brief sketch of life supplemented with a few questionnaires was recorded from each.

The conclusions drawn were (a) the in-law tension is the highest in the Group I, (b) The patterns of tension are different in different groups. The Group I has more tension between the mother-in-law and the daughter-in-law while in the other two groups, the tension level is much higher between the sisters-in-law. Again, Group I suffers more from the tension arising out of jealousy; Group II from tension due to economic disparity between the in-law families, while the main source of tension in Group III is poverty.

(c) The attitude towards the removal of tension are different in different Groups. Group I shows more passivity and bows down to the inevitable more readily. Persons belonging to Group II show more aggression. They prefer to take matters in their own hands and separate from the families. Group III people seem to be unable to cope with the miseries of life and many opined that death is the only solution. They appear to suffer from more intra-aggression.

#### 16. Crime and punishment in a Munda village.

SACHCHIDANANDA, Ranchi.

Detailed information on the legal system and the general political set up of the Munda of Chotanagpur is not yet available. The Munda are one of the most ancient tribes of eastern India and are credited with having a well organized system of administration with the Maharaja of Chotanagpur at the head. The system was broadbased and decentralized and a great deal of power rested with the village elders and the *hatu* (village) panchayat. There was a regular system of appeals in courts arranged in a hierarchal order. The union of a group of villages was called a *Parha* and cases were tried by the *Parha* panchayat. The highest court was a joint meeting of several *Parha*.

In one remote corner of the Ranchi district this system is still working vigorously with some changes necessitated by the new influences received from outside. A review of fifteen cases at village, *Parha* and joint *Parha* levels bearing on crime and punishment at KOENARA, a Christian Munda village 45 miles south of Ranchi reveals some important facts. The verdicts of the traditional

courts command greater respect than those of Government Gram Kachehri or magisterial courts. The fear of retribution for giving false evidence is growing less. The Munda resent the formation of new elective panchayats when they have already their traditional judicial mechanism. Strengthening the existing traditional system and utilizing the *Parha* meetings for welfare work would create in the hearts of the tribals new confidence and faith in the Government.

### **Demography**

#### **17. A note on Social Mobility.**

ANDRÉ BETEILLE, Calcutta.

A survey was carried out in the office of the Calcutta Corporation to study the degree of social mobility among a certain section of the clerical staff. The results of the investigation have been presented in a tabular form.

#### **18. Demographic study of a Rabha village (Assam).**

BHUBAN M. DAS, Gauhati.

In this paper an attempt has been made by the writer to present a demographic picture of a Rangdani Rabha village of Goalpara District, Assam. In doing so, analysis has been made of family size and composition, age-group, sex-ratio and marital condition of the total population of the village.

It has been found that the majority of the families are small in size; and simple type of family occurs dominantly. In the total population, the number of female members slightly exceeds that of males. The percentage of senior members (above 50 years of age) is significantly low. Child marriage is not encouraged by the Rabhas of Salpara. Cases of divorce and re-marriage are very rare.

### **Prehistory**

#### **19. Migratory factors of mill labour in Howrah and resultant changes in their food and recreational habits.**

SURENDRA KUMAR NAVLAKHA, Calcutta.

Study of the out-migration of the rural people of Uttar Pradesh and Bihar to Howrah Jute Industrial Belt reveals various factors, including economic and social, and some selective factors like age and feasible-predisposition, which influence the migratory activity. The migration is described as a shift-over movement. Changes in food and recreational habits are also recorded. Random sampling was applied for surveying and interviews were based on partially pre-controlled questionnaires.

#### **20. Microlithic Industry of Singhbhum.**

D. SEN and UMA CHATURVEDI, Calcutta.

The microliths described in this paper were found in the valley of the Sanjal river near Chakradharpur in Singhbhum district of South Bihar, adjacent to the celt-site discovered earlier. The finds include blades, points, arrowheads, blade

and core scrapers, geometric forms and a pseudo-awl, besides cortex and waste flakes. A detailed classification of the finds has been attempted in this paper.

**Applied Anthropology, Museology etc.**

**21. The Gujjar Problem : A study in Social and Economic Welfare.**

A. N. RAINA, Srinagar.

The problem of the Gujjars has so far been a problem of nomadism. In undivided India mobility of these tribes involved little danger in so far as these unruly people lived in regions of higher altitude in summer and at a lower altitude in winter. Their migratory character presented no serious problem.

In the State of Jammu and Kashmir the Punjab plains have attracted as many as 4,02,781 Gujjars who move across the mountain passes to the surrounding hills of the Kashmir Valley in summer. Now that the frontiers have been laid down between Western Pakistan and the State of Jammu and Kashmir, there is need of settling the Gujjars down in pastoral and agricultural pursuits, in the interest of peace between the two states.

In a population of 40 lakhs, 4,02,781 Gujjars form a valuable element of the State population, which, if looked after properly, will rise in the social scale to play its part in shaping the future.

**22. Arrangement of specimens in an Ethnographic Museum for Applied Anthropology.**

B. K. ROY BURMAN, Calcutta.

The present practice of labelling of museum specimens with reference to single system of classification has concealed the fact of cross-cultural difference of role of different specimens and thus has created much confusion. The author has suggested that a Museum connected with applied anthropology, which is expected to help in bringing about desirable changes in the standard of living of the people and in the pattern of utilisation of the technical achievements of mankind should study the place of the specimens in the life of the specific people under specific conditions and arrange them accordingly. The author has thus examined the specimens collected by the Cultural Research Institute of West Bengal depicting different aspects of life of different tribes of the State and has given suggestions for classifying some of the typologically similar specimens under different groups in conformity with their role in the cultures concerned.

## SECTION OF MEDICAL AND VETERINARY SCIENCES

*President* :—DR. C. R. DAS GUPTA, M.B., D.T.M., F.N.I.

### *Abstracts*

#### A. MEDICAL SECTION

##### 1. Pollen survey in Rajasthan in relation to Pollen Allergy.

R. M. KASLIWAL and J. P. SETHI, Jaipur.

A pollen survey in Rajasthan has been conducted as a preliminary step towards finding out the allergenic pollens. During the last one year that this work has been carried out, a 'Pollination calendar' showing the seasonal preponderance of various pollens has been charted. For this purpose a field study of the local botanic flora has been done. Plant specimens are collected, identified and their photographs taken. Seasonal collection of pollens from such plants is done in glazed paper bags, their drawings made and photomicrographs taken for future reference. A daily census of the concentration of various types of pollens of grasses, weeds and trees in the atmosphere has also been studied all the year round. Aerial study of pollens is done by gravity slide method of Hyde using a standard sampling device (Durham). A co-relation of aerial pollen concentration and incidence of respiratory allergies both in-patient and out-patient departments of S.M.S. Hospital Jaipur, has also been carried and it is observed that this concentration is more or less directly proportionate to the rise in incidence of respiratory allergy cases.

##### 2. Studies on Influenza.

D. W. SOMAN and Y. S. NIMBKAR, Bombay.

With the establishment of a W.H.O. Influenza Centre at the Institute in 1951, efforts were directed mainly to the isolation and typing of influenza strains. In spite of absence of any widespread epidemics in the country during the last five years, 14 strains of Influenza Virus were isolated from about 110 throat-washes subjected to the isolation procedure. All these strains excepting one, which is recently isolated, have been serologically typed and confirmed by the World Influenza Centre, London.

The main difficulties faced in this work were: (1) the paucity of material referred to the laboratory due to absence of large-scale epidemics, (2) the reluctance on the part of patients to part with blood, and (3) in certain cases the information about the illness was received very late after the onset, with the result that the chances of isolation of the strain became remote.

It was observed that use of only standard strains and their homologous sera in Haemagglutination inhibition test for typing does not give clear-cut results. This difficulty was overcome by including some of the recently isolated strains and their homologous antisera.

Out of 14 strains, isolated 11 were typed as "A" and 3 were found to belong to type "B". The isolation procedure was also accompanied by serological examination of patients' sera collected during acute and convalescent phase of illness.

**3. Comparison of Toxicogenicity Tests of C. Diphtheria by three different methods.**

D. W. SOMAN and KUMARI K. C. PATEL, Bombay.

Till 1928 the standard method for testing the virulence of C. Diphtheria strains depended upon observing the cutaneous reaction following the intracutaneous inoculation of pure cultures of C. Diphtheria. However, with the advances in research two more methods have now been introduced. In 1936 Bleck and Ouchterlony independently reported the use of an *in vitro* method for this purpose. The test makes use of the principle of toxin-antitoxin reaction in gels indicated by formations of specific lines at the points of optimum concentrations of specific toxin and antitoxin on an agar plate.

The second method reported by Evans makes use of developing chick embryos for testing the toxigenicity of Diphtheria cultures. In this method pure cultures are inoculated on the choriocallantoic membrane of 9-10 day old embryos. The toxigenic strains kill the embryos in 96 hours, while with non-toxigenic strains the embryos survive till hatching.

In the present study 35 strains of C. diphtheria including 3 non-toxigenic strains isolated locally were tested by all the three methods mentioned above. Good correlation was observed in the results furnished by the three tests. However, the agar plate method and the chick embryo method are superior to g.pig test as they are more economical and simple in technique.

**4. Fractionation of the soluble antigens of Pasteurella pestis.**

N. V. BHAGAVAN, Y. S. NIMBKAR and S. S. RAO, Bombay-12.

The supernatant of plague vaccine was found to contain 3 antigens in large amounts and four antigens in small amounts when tested by gel diffusion precipitin test. The total antigens were precipitated by saturation with ammonium sulphate and the dry powder was extracted successively with ethylene glycol, diethylene glycol and saline. The first two extracts were antigenic and protective, while the saline extract was not protective. The three extracts represented fairly pure samples of each of the three major antigens.

**5. Some recent drugs in the treatment of Collapse stage of Cholera.**

H. N. CHATTERJEE and P. C. GHORAI, Calcutta.

For raising the arterial blood pressure of pulseless cholera cases in the stage of collapse and for the treatment of peripheral circulatory failure, four drugs viz. :

"Veritol" (B-p-oxyphenyl-isopropyl-methylamine);

"Synkalton" (p-methylamino-ethanophenol tartarate);

"Carnigen" (a mammalian organ extract plus racemic-p-hydroxyphenyl methyl amino propanol hydrochloride); and

"DOCA" (Desoxycorticosterone acetate were given a trial.

"Veritol" was not able to raise the arterial blood pressure in any significant way when given intravenously with the transfusion salines in a series of 4 cases.

"Synkalton" raised and improved the blood pressure temporarily when injected intravenously. This beneficial effect could be prolonged if it was given with saline transfusions followed by "DOCA" given intramuscularly. Thirty-six cases were treated by this combined method.

"Carnigen" when mixed with the intravenous transfusion fluids improved both the systolic and diastolic phases of blood pressure, more definitely than the

"Syncalton"—"DOCA" combination. Twenty-one cases received this treatment. When however, given intravenously undiluted it produced Tachycardia extra-systoles and hyperpiesia.

Completely unresponsive cases were fewer with Syncalton-Doca combination than with Carnigen. The former appears to be preferable in children and the aged.

#### **6. Further observations on the control of Hyperpyrexia in Cholera.**

H. N. CHATTERJEE and S. K. DAS, Calcutta.

Desoxycorticosterone Acetate given intramuscularly in 10 mg. doses in 15 cases of Cholera prevented the hyperpyrexial reaction of cholera and was also able to bring about a quicker defervescence as compared to control cases.

#### **7. A new mode of growth and multiplication in *Vibrio Cholera*.**

MOITRA, N. M., Assam.

Lohin and Heurci noticed that spherical buds are thrown out terminally and laterally from the body of the vibrio cholera. Bruce-White demonstrated the spherical buds as secretory in nature. The author's previous paper on theoretical and hypothetical considerations suggested that besides secretory cells, there are reproductive cells, (gonidia, conidia). To reveal the reproductive cells, the author rejected the old method of flagellar staining by Plimmer and Pains method, prepared his slide in a modified way and on staining the slide for flagger staining, it was seen under the microscope with an oil immersion lens. Embryonic vibrios were seen coming out of the reproductive cell (conidia or gonidia).

#### **8. Role of various fats in the pathogenesis of Atherosclerosis. (An experimental study in the Chick).**

K. N. GOUR and O. P. GUPTA, Agra.

The influence of exogenous lipids in the diet has been emphasised as one of the important contributory factors in the pathogenesis of atherosclerosis. For experimental purpose six groups of four chicks each were taken for this study. The basic diet of each group was 'bajra'. The experiment was carried out in six groups with four chicks in each group. One group fed on this served as control and the other groups in addition were given cholesterol, 'ghee', 'dalda', cocoanut and mustard oil for a period of 32 weeks.

At the end of 32 weeks, the experimental period, it was observed that 0.5% cholesterol produced atherosclerotic lesions in the aorta and coronaries while 'ghee' and different vegetable oils in 15% concentration could not do so. These neutral fats, however, produced fatty changes in the liver. The atherosclerotic lesions consequent upon cholesterol feeding were associated with a gross rise in plasma total cholesterol (P.T.C.) and also there was increase in the total cholesterol/plasma lipid phosphorus ratio (C/P ratio). 'Ghee' and vegetable oils did not produce any appreciable rise in P.T.C. or C/P ratio but produced inhibitory effect on dietary intake and retardation of growth and development. Out of these fats 'dalda' had the worst influence on growth. Cholesterol produced no such deleterious effects.

Our experimental studies reinforce cholesterol lipid concept of atherogenesis.



**9. Liver function tests in Congestive Cardiac Failure.**

D. P. BASU and K. B. BAKSHI, Calcutta.

13 cases of congestive cardiac failure were studied during the acute illness and later after recovery.

Total cholesterol was estimated from the plasma based on the method of Sackett, free cholesterol was determined by slightly modified form of Clark's adaptation of the digitonin precipitation method of Sperry. Cephalin cholesterol was estimated based on the method of King.

The following are the observations :

(a) The abnormality consists in a reduction of combined cholesterol of the plasma.

(b) There is a rough correlation between the degree of liver enlargement and abnormality of  $F/T \times 100$ , but not in all cases with the Cephalin cholesterol flocculation test.

(c) Patients with several previous episodes showed much smaller increase of total cholesterol during the recovery phase and in these  $F/T \times 100$  showed a continuing abnormal value with a residual liver enlargement, whereas, flocculation with cephalin cholesterol was not positive in all cases.

**10. Treatment of Leucoderma with parenteral pituitary gland.**

G. PANJA and S. N. CHAUDHURI, Calcutta.

Pituitary gland therapy was tried in 50 cases of leucoderma which baffled the routine treatment. Fresh pituitary gland was taken out of young goats or sheep, emulsified in Ringer's solution and was immediately injected intramuscularly deep into gluteal muscles once a week upto 5 or 8 as a rule or more. Improvement was noticed in three to four weeks. 6 cases were completely cured, 21 improved partially and 23 did not improve. The failure might be due to incomplete treatment or it is possible that there might be some other cause of the disease besides the pituitary MSH hormone. Appearance of pigment on the lips, palms, soles and sides of feet was remarkable, as no other forms of treatment gave such a striking result.

**11. A preliminary report on the use of Placental Extract in skin diseases.**

G. PANJA and S. N. CHOWDHURY, Calcutta.

Technique of the preparation of placental extract and the mode of its administration are given. The underlying principle in the use of the drug is that a 'biogenic stimulator' develops in the tissue when it is stored away from light at a temperature of  $2^{\circ}\text{C}$  to  $4^{\circ}\text{C}$ . Such a stimulator possesses the power of stimulating vital and regenerative processes in the body. The extract has been used with success in psoriasis, trophic ulcers of leprosy, lupus erythematosus and some other skin diseases. This is only a preliminary report and further experiments are in progress.

**12. Clinical observations on the incidence of hyperpigmentation of skin in intestinal parasitic infections.**

K. C. SAHU, Cuttack.

Hyperpigmentation (blackish discolouration) was observed in series of twenty one patients, suffering from various intestinal parasitic infections. These intestinal

parasites produce directly or indirectly starvation, nutritional deficiencies and digestion upset of proteins. Lack of proteins results in shortage of tyrosinase and tyrosine and similarly protein lack might result in tissue shortage of cysteine and glutathione with consequent pigmentation. The pigmentation might be due to all melanin being present in its black form owing to lack of reducing action of ascorbic acid, depressing inhibitory effect of SH group and hence increasing the tyrosinase activity.

Diagnosis in each case was established by repeated stool examinations by ordinary and in some cases by concentration methods and by elimination of other diseases like Addison's disease, syphilis etc. by their appropriate investigations. Out of twenty one cases eleven were due to Amoebiasis, five due to Ascariasis and five due to Ankylostomiasis. The incidence was highest in the age group 20-30, percentage of incidence being 47.6%. Males constituted 71.5% of the cases observed, the incidence of males to females being in the ratio of 2½ : 1 approximately. One out of these cases occurred in a female child.

The pathogenesis of the condition is discussed.

#### 12(a) On Schistosome dermatitis in India—with a description of the casual parasite—*Cercaria srivastavae*, n. sp.

S. C. DUTT, Izatnagar.

Although dermatitis is a very common condition in India especially among fishermen and agricultural labourers who come in frequent contact with natural waters, schistosome dermatitis has not been reported from this country. The present paper reports natural and experimental dermatitis due to a new cercaria—*Cercaria srivastavae*, n. sp., shed by *Lymnaea acuminata*.

**Specific diagnosis of the cercaria:** Schistosome cercaria of the *Ocellata* group. Mean dimensions in microns: Body 254 × 63; Tail-stem 482 × 41; Furcae 273; Distance of ventral sucker from tail attachment 81; Head organ 87 × 46; ventral sucker 27; Distance of eyes from anterior extremity 125; Intestinal caeca situated a little behind the nerve-mass. Penetration glands five pairs. Escape glands in unemerged cercariae. Flame cell formula 2[3+3+(1)]. Emergence during early morning hours. Positively phototropic. Characteristic attachment on the side of the container towards light by means of ventral sucker.

The cercaria can be differentiated from others of the *Ocellata* group by its size and behaviour. Attempts to raise the adults of the cercaria were unsuccessful. Wild aquatic birds, especially ducks which frequent the pond in winter, may be the definitive hosts of the adult parasite which is probably a species of *Trichobilharzia*.

Natural dermatitis was found to be common among the people who frequent the pond for collecting water chestnut and aquatic vegetation. Experimental dermatitis was produced in three human volunteers.

#### 13. Use of Crotonyl-N-ethyl-toluidine in Pediculosis.

K. C. SAHU, Cuttack.

Following the reports of the high acaricidal effect of Crotonyl-N-ethyl-toluidine, on human beings, this drug under the name Eurax was given a clinical trial in nine cases of Pediculosis in the skin clinic of S.C.B. Medical College and Hospital, Cuttack. It is found to be a good parasiticide for Pediculosis capitis, corporis, and capitis. Ten per cent of this ointment incorporated into a nongreasy,

nonirritating base is effective against Pediculosis and has got a bacteriostatic effect on strepto and staphylococci, producing impetigo of the scalp due to scratching and does not irritate or harm the scalp and skin. It is well tolerated by both the children and adults and no irritation or exanthematic reaction of the skin, has been experienced. No toxic manifestation of resorption were observed. It has got antipruritic effect. It does not soil the clothes. It is simple and odourless, and does not irritate the skin even on prolonged application is very pleasant in its use.

In about 3-4 days of administration of this drug, the patients got rid off the Pediculosis. It is well tolerated by the patients and is efficacious.

#### 14. Cashewnut shell oil in the treatment of *Hymenolepis nana* infection.

N. V. BHADURI and P. K. SANYAL, Calcutta.

*Hymenolepis nana*, the dwarf tapeworm is quite a common intestinal parasite of man in India. The fact that the worm is capable of increasing in number in the same host without the aid of an intermediate host, may be the reason that there are vague digestive troubles in some persons. The treatment for this infection has been very unsatisfactory so far. The prepared extract from the shells of cashewnuts (*Anacardium occidentale*) has given encouraging results. Seventeen cases (adults) were given treatment with a dose of 5 to 6 gr. Six were cured by one treatment and five more cases by a second treatment while five cases were not cured. One case could not be followed up.

#### 15. Observations on Mechanical Fragility of red cells.

J. B. CHATTERJEA, S. K. GHOSH, R. N. RAY and C. R. DAS GUPTA, Calcutta.

Using a modified method of Shen, Castle and Fleming (Science, 100:387, 1944) mechanical fragility was determined in 69 cases, comprising normals 5, iron deficiency 11, nutritional macrocytic anaemia 11, dimorphic anaemia 7, Cooley's anaemia 18, Cooley's trait 16 and hereditary spherocytosis 1. Normal range of mechanical fragility with this technique was 2.32% to 4.80%. In hereditary spherocytosis, nutritional macrocytic anaemia and Cooley's anaemia the mean values were higher than normal and ranged from 5.10 to 5.95%. In Cooley's trait mechanical fragility was normal.

#### 16. Specific morphological feature in neutrophilic granulocyte as a guide to the diagnosis of Sex.

J. B. CHATTERJEA and A. K. BASU, Calcutta.

Studies were undertaken to find out whether there was any significant morphological feature by which sex could be identified from the 'haemic' cells. Peripheral blood and bone marrow smears were evaluated for the presence of characteristic solitary nuclear appendage with a typical "drumstick" appearance, as described by Davidson and Smith in the neutrophilic granulocytes. The female character, as identified by this characteristic feature in the mature neutrophilic granulocyte in blood and bone marrow, was in general found to be sufficiently specific for the diagnosis of sex in normal population. In addition, such a differential feature was also seen, though less distinctly, in the eosinophilic granulocyte.

**17. Studies on Plant Anticoagulants.**

N. C. PILLAI, G. J. SATHYANARAYANA RAO and M. SIRSI, Bangalore.

In recent times the anti-coagulant therapy has assumed an important role in the treatment of thrombosis and allied blood dyscrasias. The widely used anti-coagulants are Coumarin derivatives and Heparin. While the prohibitive cost and the short period of action limit the usefulness of heparin, the synthetic compounds suffer from the unpredictability in the extent of their effect and the cumulative toxicity after continuous administration.

In the indigenous system of medicine, many plant products are used in clinical disorders needing anti-coagulant therapy. An evaluation of some of these plant products as regards their anti-coagulant property has been carried out and reported in this communication.

Of the seven plant sources investigated, viz., *Boerhaavia diffusa*, *Picrorhiza kurooa*, *Andrographis paniculata*, *Phyllanthus emblica*, *Vitis vinifera*, *Carica papaya* and *Citrullus colosynthis* the last four were found to contain some anticoagulant principles. Of these, the extract from *P. emblica* was found to contain an active lytic factor and that from *V. vinifera* a strong agglutinating factor, associated with the anticoagulant principles. The extracts from the fruits of *C. colosynthus* and that from *C. papaya* latex were found to be very active inhibitors of clotting devoid of other undesirable effects in the *in vitro* studies against both plasma and whole blood.

**18. Some observations on the Cytochemical constituents of *Mycobacterium leprae* and Leprous tissue.**

K. R. CHATTERJEE, H. N. RAY and N. MUKERJEE, Calcutta.

In this article the authors present their observation on the cytochemical make up of *Mycobacterium leprae* as well as of the leprous tissue.

The central zone of the leprosy bacillus was found to be Feulgen positive and also took green stain by Byronin Methyl Green technique. It might, therefore, be assumed that the DNA containing central dot is the nucleus of the bacillus. In some dividing forms of the bacillus the DNA appeared to have concentrated towards either pole of the nucleus simulating a mitotic figure. The alkaline phosphatase activity was definitely stronger in a dividing nucleus than in a resting one. The reaction of RNA was more intense in the cytoplasm of the bacillus than in the cell wall and cell membrane. The nucleus gave a positive reaction for acid polysaccharides with Hale method. Cytoplasm and the cell membrane revealed the presence of mucopolysaccharides when stained with toluidine blue. The lipids present in the bacillus were more concentrated in the polar bodies which were also NADI positive and contained cytochrome oxidase and thus were the sites of the mitochondria.

The cytochemical study of the leprous tissue showed the increased activity of the alkaline phosphatase in the nuclei of the cells, nerve fibres and endothelial lining of blood vessels where the bacilli were present in large numbers. This was also true of polysaccharides, the concentration of which was more in the sites where the bacilli were aggregated in large numbers. The cytoplasm of macrophage cells gave strong metachromasy with Toluidine blue in the same manner as the body of the bacillus suggesting a common type of metabolic process. Bacilli were seen to thrive well within these macrophage cells. The intracellular lipids of vacuolated cells (foamy cells) were found to be bound in the form of a lipido-calcium phosphate complex.

**19. Role of Bombax Malaricum in sex neurasthenic impotency.**

K. C. SAHU, Cuttack.

In the modern world, many a psychopathic individuals, under the stress and strain, become sexually neurasthenic. This condition presented a varied clinical picture among a series of thirty-five cases, observed: impotency, diminished sex-desire, frigidity loss of erectile and retentive power and ejaculatio praecox. The vernacular name of *Bombax malabaricum* is Shimul in Bengali, Semeli in Oriya and Shalmali in Sanskrit. Its roots known as musla or Semula musla have stimulant and tonic properties of sex. Shalmalee root juice is very helpful in impotency and sex debility, produced by excessive coitus. It stimulates the erectile centre and improves the retentive power. It has been tried successfully on thirty-five patients over a period of three years in the Skin and V.D. Clinic of S. C. B. Medical College and Hospital, Cuttack in the dose of 0.5 grains twice daily. Organic causes of sex-neurasthenia and impotency were eliminated before starting the treatment with the root juice. Relapses no doubt, occurred but they were amenable to the treatment with the same also.

**20. Electro-myographic changes in Experimental Nerve Paresis.**

N. N. DAS, Calcutta.

Muscle action potentials were recorded with Electro-myograph to study the changes due to nerve block produced by cold. Ulnar nerve was selected for artificial cooling as it is superficial near the elbow joint. The E.M.G. changes were recorded with the help of Electro-encephalograph cum Electro-myograph and Oscillograph. This study may help in understanding the polyphasic changes in pathogenic condition of nerve paresis and muscle atrophy.

**21. Physiological study of human milk and its correlation with the subnutritional status of the newborn in India.**

AMALA CHAUDHURI, Calcutta.

A study of 123 newborn, full term, healthy babies and their mothers has been made with respect to the effect of breast milk on the nutritional state of the infants during the first ten days of life. Values for haemoglobin, total protein, albumin, sugar, calcium and phosphorus of the babies' blood at three different stages during the period of observation were estimated. Carbohydrate, fat, protein and calcium estimations of the mothers' milk were also carried out.

The values of blood and milk obtained in the study are presented. There was no association between the maximum loss in weight of the babies during the first week of life and changes either in blood and milk. The study reveals that the milk and blood protein are significantly higher in the lower than in the higher economic groups. The conclusion is drawn that no correlation exists between the constituents of breast milk and the nutritional status of the babies at least during the first ten days of life.

**22. Investigation on Chemical Composition and Pharmacological action of Saraca Indica (Ashoka).**D. K. ROY CHOWDHURI, S. N. DUTTA, N. K. DASGUPTA, B. N. GHOSE,  
N. K. BHATTACHARYYA, Calcutta.

*Saraca Indica*, commonly known as Ashoka has been used in Hindu Medicine for a long as a remedy in various disorders of the uterus. The chemical and

pharmacological investigation of the bark of Ashoka has been undertaken. The different extracts were made with Petrol Ether, Ethyl Ether, Chloroform, Ethyl Alcohol, water and extracts were, then, subjected to further chemical investigations. The various partially pure fractions so obtained show presents of alkaloidal and glycosidal compounds. The pharmacological investigation includes a preliminary study on the uterus of albinorats and guineapigs. Some fractions have been found to be effective uterine stimulant. It should be mentioned, however, that there are also some depressant fractions. The depressant fractions help smoothening of the erratic uterine contractions. It appears from the present work that the purified form of active compound of the Ashoka may prove useful in the modern system of medicine.

### 23. Preliminary observations on the pharmacology of *Cassia sophera*, Linn.

P. SURYANARAYANA MURTHY and M. SIRSI, Bangalore.

Many medicinal properties are attributed to this plant. It is said to possess antifungal, and antispasmodic properties and is considered a specific for ringworm and to be highly useful in asthma.

An evaluation of some of the pharmacological properties of the alcoholic and water extracts has revealed :

1. Both the extracts cause relaxation of the tone of the isolated guinea pig ileum and antagonise the spasms induced by histamine, acetylcholine and to a limited extent the responses due to Barium and Potassium chloride.

2. The spasmolytic action is better observed when the drug is perfused after the induction of the contracture by the spasmogens.

3. In the tracheal chain preparation of the guinea pig also, the extracts antagonised the action of Ach, histamine and barium and relaxed the spasms induced by these spasmogens. The effect was more prominent on Ach. contraction than on those of histamine and barium.

4. Haemodynamic studies show a transitory fall in blood pressure and diminished amplitude of respiration but did not alter the responses elicited by adrenaline, acetylcholine and carotid occlusion.

The extracts are thus found to exhibit both musculotropic and neurotropic spasmolytic actions in these 'in vitro' studies.

### 24. Pharmacognostic study of the flowers of *Nerium odorum* Soland (Rakta Karavi).

P. K. SANYAL and H. K. Das, Calcutta.

Roots, barks and flowers of *Nerium odorum* Soland are used in India by the Ayurvedic Physicians. In Europe the barks and flowers of *Nerium oleander*, which is closely allied to *Nerium odorum* have been used. The chemical investigation of the constituents of barks and roots have been carried.

Under the present investigation the study of the flowers of *Nerium odorum* have been undertaken. The full morphological character of the garden varieties of Raktakaravi have been described. The following results were obtained from the flowers.

Average moisture content of the flowers was 81.4 per cent.

Average steam volatiles content of the flowers was 0.50 per cent as calculated for dry flowers, and 0.1 per cent as determined for fresh flowers.

Ether soluble extractive was 9.0 per cent as determined for dry flowers and 1.7 per cent as calculated for fresh flowers.

Chloroform soluble extractive was 6.3 per cent as determined for dry flowers and 1.2 per cent as calculated for fresh flowers.

Methyl alcohol soluble extractive las 48.0 per cent as determined for dry flowers and 9.0 per cent as calculated for fresh flowers.

Ethyl alcohol soluble extractive was 46.2 per cent as determined for dry flowers and 8.6 per cent as calculated for fresh flowers.

The active principles were water soluble.

The action of the drug was found to be very similar to that of *Digitalis*.

## 25. Preliminary pharmacological observations on some Indian species of *Viburnum*.

N. K. ROY, Calcutta.

*Viburnums* are being widely used in folk-medicine, from the most uncritical period of therapeutics, as a 'female weakness' remedy in treating uterine diseases, characterized by loss of blood and in threatened abortion. The drug has been introduced in Clinical medicine during the last part of the 19th Century and is now being extensively used. Though various species of *viburnum* grow in India, bulk of the raw material is imported from abroad, observations on *Viburnum faetidum* growing at an altitude 3000—5000 ft. in the Himalayan regions, Assam, Khasia mountains and *Viburnum coriaceum* growing at 4000—8000 ft. in plenty in Darjeeling districts, show that, both the species initially stimulate the intestinal rhythmic contraction, which soon disappears with mild depression of short duration. The intestinal musculature soon regains its original tone. Their antispasmodic action is, however, more marked on the uterus. On the uterus of guinea pig and rats they do not cause any initial stimulation. The sedative effect in relieving irregular and violent contractions of that organ, is a steady lowering of the height of the contraction with ultimate complete inhibition. The effect, again, is more sustained and complete with *Viburnum coriacum*. Preliminary comparative studies show promising results. The Indian species are expected to be good substitutes for the foreign ones. Through pharmacological and clinical observation may result in better utilization of the country's natural wealth and help grow a new industry.

## 26. European valerian, its structural characters with regards to its Polyploidy Form.

PROMODE K. SANYAL, Calcutta.

The common valerian, *Valeriana officinalis* Linn (Family Valerianaceae) which mainly grow in Europe and Northern Asia, vary much in character and exhibit many divergent forms to which varital names of *Sambucifolia*, *mikanii* etc. have been given. The work of Skalinska (1947) and others appears to render these varital names obsolete; the difference being shown to be due to polyploidy. Skalinska records the occurrence of diploid, tetraploid and octoploid plants.

The commercial drug does not show any morphological differences between the polyploid forms, but histological characters of some parts of plants show some difference, by which the two varieties viz., the octoploid and tetraploid form might be distinguished.

*Valeriana officinalis* Linn. of commerce occurs in two polyploid forms—tetraploid and octoploid. These two forms have been examined and are found to be closely similar anatomically. The differences observed are—

1. The presence of sclereids in the diaphragm of the pith of the rhizome in tetraploids, but their absence in octoploids.
2. The starch granules in the roots of octoploids have a maximum diameter of 30  $\mu$  while those of tetraploids have a maximum of only 18  $\mu$ .
3. The pollen-grains and the stomata of the octoploids are larger than those of the tetraploids.



27. A preliminary note on the pharmacognosy, chemistry and pharmacology of *Rauwolfia canescens*, Linn.

D. D. DATTA and M. D. CHAKRAVARTI, Calcutta.

*Rauwolfia canescens* Linn are often sold in the market as substitute for *R. serpentina*. The important histological characters of the root of *R. canescens* are discussed and illustrated. Preliminary chemical investigation shows that the thinnest root contain the maximum amount of alkaloid. On preliminary pharmacological study of the drug it has been found that the drug is an adrenolytic agent and promises to be a better hypotensive drug than *Rauwolfia serpentina*.

28. Latency in hypotensive action of total *Serpentina* Alkaloids, Reserpine and Protoverine in dogs.

B. S. KAHALI and M. L. GUPTA, Jaipur.

Hypotensive action of total *Serpentina* alkaloids, Reserpine and Protoverine has been extensively studied. Latency in action of these hypotensive drugs has been investigated on intravenous and oral administration in stomach through Ryle's tube.

It has been observed that *Serpentina* alkaloids (0.5 to 2.0 mgm./kg.) have an immediate hypotensive effect which is not maintained and comes back to normal level within a variable time depending on the dose. Reserpine (0.1 mgm./kg.) has no immediate hypotensive effect. The fall of blood pressure appears after 15 minutes and progresses and is maintained for more than 5 to 6 hours. Protoverine (0.006 to 0.012 mgm./kg.) has an immediate hypotensive effect which is maintained for about 45 minutes.

The effective oral dose for Reserpine is 2 to 4 times (0.2 to 0.4 mgm./kg.), for *Serpentina* 6 to 8 times (3 to 4 mgm./kg.) and for Protoverine more than 8 times (0.05 mgm./kg.) the intravenous dose. The fall of blood pressure is obvious after 75 minutes with Reserpine, 90 to 120 minutes with *Serpentina* and 120 to 150 minutes with Protoverine. For oral administration Reserpine is better than *Serpentina* while Protoverine is unreliable.

*Serpentina* alkaloids have got slight stimulating effect on respiration while Protoverine has got greater depressing effect than Reserpine. Reserpine causes increased peristaltic movements and general sedation while these effects are not seen with *Serpentina* and Protoverine.

29. Hypotensive effect of various combinations of hypotensive drugs in dogs.

B. S. KAHALI and M. L. GUPTA, Jaipur.

Latency in hypotensive action of total *Serpentina* alkaloids, Reserpine and Protoverine has been reported elsewhere by the authors. Hypotensive effect of various combinations of these drugs has been investigated on intravenous and oral administration.

It has been observed that given intravenously *Serpentina* (1 mgm./kg.) cum Reserpine (0.1 mgm./kg.) causes a immediate fall due to *Serpentina*—the fall of blood pressure is subsequently maintained by Reserpine. With protoverine (0.012 mgm./kg.) cum Reserpine (0.025 mgm./kg.) there is an immediate fall due to Protoverine. After 15 to 30 minutes there is a second fall due to Reserpine which is maintained by Reserpine and possibly also by Protoverine. With *Serpentina* (0.2 mgm./kg.) cum Reserpine (0.02 mgm./kg.) cum Protoverine (0.012 mgm./kg.)



the immediate hypotensive effect is more marked and the blood pressure is maintained at a lower level. The immediate hypotensive effect due to *Serpentina* is enhanced with *Protoverine*—the subsequent fall of blood pressure is maintained by *Reserpine* and possibly also by *Protoverine*.

The effect on oral administration of these drugs appear after 75 to 120 minutes and is less intense than that after intravenous injection.

It is suggested that in mild hypertension *Serpentina* alkaloids (5 mgm.) potentiated by *Reserpine* (0.5 mgm.) given orally three times a day is the preparation of choice. In malignant hypertension and hypertensive crisis when vigorous treatment is necessary *Serpentina* alkaloid (2 mgm.) cum *Reserpine* (0.25 mgm.) cum *Protoverine* (0.12 mgm.) given intravenously, very slowly, may at times be life saving.

### 30. Prolonged hypotensive effect of the essential oil of *Nardostachys jatamansi*.

R. B. ARORA, K. P. SINGH and P. K. DAS, Jaipur.

Preliminary experiments with the essential oil of *N. jatamansi* in dogs showed that it has prolonged and pronounced hypotensive effect lasting for several hours. The mechanism of this hypotension was investigated by experimenting on intact and spinal dogs and cats, and on isolated frog's heart. In doses of 0.1 to 1.0 mgm./Kgm. it caused moderate or marked fall in blood pressure lasting for 2 to 6 hours or more. It showed tachyphylaxis. Intracisternal administration and spinal animal experiments showed that it does not depress vasomotor centre. It was found to block proprioceptive blood pressure regulating reflexes. In dog's and frog's hearts it had negative inotropic and positive chronotropic effects. In moderate doses it had no effect on E.K.G. pattern. It did not block autonomic ganglionic transmission but had some adrenolytic action. It caused stimulation of respiration more in rate and sometimes in volume.

The drug appears to cause hypotension by peripheral vasodilator action, while negative inotropic, depression of proprioceptive blood pressure regulating reflexes and adrenolytic actions are contributory factors. The investigations suggest its possible use in cases of hypertension.

### 31. Valerian through ages—European and Indian.

PROMODE K. SANYAL, Calcutta.

Valerian is a very old remedy having been used in European medicine since very early days. The word valerian is not found in the works of the classical authors; mention of it is, however, found in the 9th or 10th century, at which period and long time afterwards it was used as synonymous with the names Phu or Fu which are found in the writings of Dioscorides and Pliny to indicate a kind of wild nard.

Quite a number of varieties of valerian have been mentioned by different writers in the 17th and 18th century, but recent work by Mme Skelinska and others appears to render these varietal name obsolete; the difference being shown to be due to polyploidy.

In India, valerian has been used in Hindu medicine for a long time, mention of it being found in charaka. The drug is known in Sanskrit as *Tagoram* which is *Valeriana wallichii* DC. This drug has been confused by several authors notably by Sir William Jones with another India drug usually known as Indian spikenard.

and derived from *Nardastachys jatamansi* DC. Another drug *V. hardwickii* wall described by Royle (Antiquity of Hindu medicine p. 82) has been used for the same medicinal purpose, as *V. wallichii* DC. But there exists a great confusion about the actual variety of *V. hardwickii* wall even from the time of Dymock (1885). Several commercial samples sold as valerian derived from *Valeriana hardwickii* wall when examined histologically was found to be nothing but of *V. wallichii* DC.

### 32. The action of 21-hydroxypregnanedione sodium succinate (Viadril) on cardio-vascular system and respiration.

R. B. ARORA and P. K. DAS, Jaipur.

The actions of 21-hydroxypregnanedione sodium succinate (hydroxydione, viadril), a water soluble steroid anaesthetic have been investigated on the cardio-vascular system and respiration, and compared to thiopental sodium. Experiments have been done on intact and spinal cats and dogs, isolated frog's hearts (i/-perfusion, and ii/- Straub's-ventricle) and failing frog's hearts (induced by i/- high venous pressure, and ii/- low calcium). In cats and dogs hydroxydione 20 to 40 mgm./Kgm. affected the blood pressure in three phases—(i) hypotension—transient, due to vasodilatation, (ii) hypertension—for 5 to 10 minutes, due to vasoconstriction, and (iii) hypotension—due to depression of V.M. centre. It had no significant effect on cardiac rate and none on rhythm. In doses of 20 to 40 mgm./Kgm. it had no deleterious effect on auricular or ventricular contractions. In 20 mgm./Kgm. it sometimes increased auricular contractions. In frog's heart it had negative chronotropic and positive inotropic (upto a conc. of 1:30,000) effects. It also caused irregularities, and in lower concentrations increased cardiac output. In higher doses it depressed cardiac activity. It also showed cardiotonic effect in failing hearts. In 40 mgm./Kgm. it had no effect on E.C.G. pattern, P-R or R-T intervals. In frog's heart it caused broadening and prominence of T wave and increase in P-R and R-T intervals. In 20 to 40 mgm./Kgm. it depressed respiration following an initial transient phase of stimulation. There was no phase of apnoea. Thiopental in one quarter the dose of hydroxydione affected the cardiac rate, E.C.G. pattern, blood pressure and respiration more than the latter.

### 33. The action of 21-hydroxy pregnanedione Sodium Succinate (Viadril) on smooth muscles.

P. K. DAS and R. B. ARORA, Jaipur.

The action of 21-hydroxypregnanedione sodium succinate (Viadril, hydroxydione), a soluble steroid anaesthetic devoid of any hormonal activity, has been investigated on the isolated smooth muscles of intestine and trachea. In concentrations of 1:100,000 onwards it reduced the tone and the amplitude of rhythmic movements of intestine of rabbit and guineapig. In 1:50,000 concentration it reduced the acetylcholine (1:50 million) induced contraction in guinea pig's intestine by 50%. Hydroxydione in 1:50,000/1:25,000 onwards was found to reduce the tone of tracheal muscle and also showed antispasmodic action against acetylcholine induced contractions in tracheal chain of dog, cat, rabbit and guinea pig. In dog's tracheal muscle it reduced the spasm induced by acetylcholine (1:10 millions) and potassium chloride (1:250) to nearly the same extent.

The pronounced relaxant and antispasmodic properties of hydroxydione on smooth muscles are advantages over thiopental as an intravenous anaesthetic due to the absence of any danger of initiating bronchospasm during anaesthesia.

**34. Antiarrhythmic actions of essential oil of *Acorus calamus* and fixed oil of *Nardostachys jatamansi*—Indian indigenous drugs.**

R. B. ARORA and B. R. MADAM, Jaipur.

Essential oil of *Acorus calamus* and fixed oil of *Nardostachys jatamansi* were investigated for their antiarrhythmic activity in auricular fibrillation evoked by the topical application on auricle of (a) 0.05 per cent solution of aconitine and (b) 5 per cent solution of acetylcholine and auricular flutter produced by the injury-stimulation procedure in dogs. Their ability to afford protection against ventricular rhythms in anaesthetised dogs induced by hydrocarbon-adrenaline was also tested. In addition, effect of these drugs on the conduction and refractoriness were investigated by measuring the changes in the P-Q and Q-T intervals of the electrocardiogram of cats. In each case, comparison was made with quinidine.

The results obtained indicate that the two indigenous herbal preparations under trial possess significant quinidine-like activity. But the toxicity of the essential oil of *Acorus calamus* precludes the possibility of its being put to therapeutic usefulness in cardiac arrhythmias. However, fixed oil of *Nardostachys jatamansi* being less toxic than quinidine, does warrant clinical trials in selected cases of cardiac arrhythmias.

**35. Antiarrhythmic activity of B-pyrrolidine-ethyl-p-n-propoxy-benzoate hydrochloride (Pyrollocaine), Bis(o-methoxyphenyl)-isopropyl amine lactate (U-0045), Di(B-O-methoxyphenyl)-isopropyl-amine lactate (U-0063 and Thenfadil hydrochloride.**

R. B. ARORA and V. N. SHARMA, Jaipur.

The antiarrhythmic properties of pyrollocaine, U-0045, U-0069 and thenfadil were investigated, and results compared with quinidine:

(1) In acetylcholine-induced auricular fibrillation, 0.5 mg./Kg. of thenfadil reverted the fibrillating auricle to normal sinus rhythm immediately. 0.5 mg./Kg. of pyrollocaine; 1 mg./Kg. each of U-0045 and U-0069 and 2.5 mg./Kg. of quinidine brought about a comparable significant reduction in duration of fibrillation.

(2) In aconitine-induced auricular fibrillation the 'end-point' was reached with 1.5 mg./Kg. of thenfadil, 16 mg./Kg. of quinidine and 5 mg./Kg. of U-0045 and U-0069.

(3) Similarly, in auricular flutter produced by injury—stimulation method, and in their ability to avert hydrocarbon adrenaline induced ventricular arrhythmias, these compounds were found more potent than quinidine.

(4) The effects of these drugs on conduction and refractory period were similar to that of quinidine.

The intravenous LD 50 in mg./Kg. in albino mice, of quinidine, pyrollocaine, U-0045 and U-0069 were 56, 49.5, 14, 16 and 20 respectively.

Keeping the activity and toxicity in view, pyrollocaine and thenfadil seem promising and deserve clinical screening.

**36. Vasacinine an Indian indigenous analeptic in unanaesthetised and morphinised rabbits.**

R. B. ARORA and V. N. SHARMA, Jaipur.

A new water soluble and hygroscopic base, isolated from the leaves of *Vasaka*, was investigated for its respiratory stimulant activity in unanaesthetised and morphinised albino rabbits. Its molecular formula is  $C_8H_{11}NO_2$ , and it appears to be a pyrrolidine derivative.

The effects of aqueous solution of Vasicinine hydrobromide were studied on albino rabbits weighing 1.2 Kg., and cardiozol was used as a standard drug for comparison. All the solution were injected intravenously in the ear vein. It was found that—

(1) 0.25 ml. of 1 per cent solution of Vasicinine caused 28 per cent increase in the respiratory rate during the first five minutes. The rate returned to normal in 15 minutes.

(2) 0.1 ml. of 1 per cent solution of cardiozol produced 15 per cent increase in the rate for first five minutes and the effect lasted for 25 minutes.

(3) 0.2 ml. of 0.25 per cent morphine Hcl. produced 50 per cent reduction in the rate during first five minutes and the depressed state of respiration lasted for 75 minutes.

(4) In morphine-induced depressed state of respiration with the above dose of morphine, it was found that if 0.2 ml. of 2 per cent solution of Vasicinine was injected soon after morphine, the reduction in the rate was only 26 per cent instead of 50 per cent, and the depression was also short lived (25 min.). 0.1 ml. of 1 per cent cardiozol could increase the rate to 23 per cent, effect lasting for 1 minute.

Thus Vasicinine shows sufficient promise as a respiratory stimulant.

### 37. Preliminary report on the effect of the green leaves of *B. tulda* on isolated intestines.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

The effect of the green leaves of *Bambusa tulda* was studied in a Dale's Isolated Organ bath. The leaves were pressed through an electrical mincer and the crude juice extracted. The effect of the crude juice was studied on isolated intestines of Rats and Goats. It was observed that in every instance the crude juice stimulated the tone of intestines. In dilutions below  $2.5 \times 10^{-4}$ , the results were variable while in doses from and above the dilution of  $2.5 \times 10^{-3}$ , the effect on the tone was pronounced. With increasing doses no correlation could be established between the dose and the increase in tone as measured in mm.

### 38. Studies on the isolation of the factor in *B. tulda* affecting the tone of isolated intestines.

A. CHATTERJEE and D. P. SADHU, Calcutta.

The green leaves of *Bambusa tulda* has been found to possess stimulatory effect on the tone of isolated intestines. The factor responsible for the physiological action is soluble in water, dilute acid, dilute alkali and grades of alcohol. Further studies were carried out with the extracts to find out the probable nature of the active principle. It was observed that the active principle was not a glucoside. The leaves contained 3.0-0.2 gm% of total alkaloids, but the alkaloids were not responsible for the effect. The alkaloid free filtrate produced stimulation of the tone of isolated intestines. The filtrate was then passed through ion-exchange resins. Both cat-ion and an-ion exchange resins retained the active principle as the filtrate through either of the resins failed to produce the designed effects. This observation suggested the amphoteric nature of the factor. The used resins were then extracted with water at room temperature for 24 hours and the extract was filtered. The filtrate, on being added to the batch in which the isolated intestines were suspended, produced the stimulation of tone. Further studies on the nature of the factor is in progress.

The effects were studied in a Dale's Isolated Organ bath.

**39. Effect of different extractives of *B. tulda* on isolated Intestines.**

A. CHATTERJEE and D. P. SADHU, Calcutta.

It was observed that the crude juice of *Bambusa tulda* increased the tone of intestines and as such attempts were made to extract the active principle in suitable solvents. The leaves were crushed and extracted for 18–24 hours with water, dilute acid, dilute alkali in one series of the experiments. The extracts were filtered and the pH neutralised before use. In another series of experiments, extractions were carried out with the following organic solvents,—Ether, Chloroform, Benzene, Petroleum ether, Acetone, Absolute alcohol and graded alcohols from 80% to 50%. The extracts were filtered, evaporated on a waterbath and the residue were redissolved in distilled water before use. The effects were studied in a Dale's Isolated Organ apparatus. The dry weight of the different extractives were obtained as follows:—Water extracts—30.65%, dilute acid extract—12.76%, dilute alkali extract—13.02%, Ether extract—0.48%, Chloroform extract—3.60%, Benzene extract—0.68%, Acetone extract—1.0%, Petroleum ether extract—0.23%, Absolute alcohol—1.94%, alcohol—3.14%, 70% alcohol—3.0%, 60% alcohol—2.21%, 50% alcohol—1.88%. The maximum physiological effects were noticed with the water extract, dilute acid and alkali extracts, and 80% alcohol extracts. With lower grades of alcohols the effect also decreased while with other extracts no effect could be observed.

**40. A modified method of perfusion of superior cervical ganglion using a blood substitute.**

J. K. MOHANTY, Cuttack.

Gallagher's medium was modified by adding 0.1% dextrone; the final make-up of which was a suspension of 40 vols. of human or sheep red cells in 60 vols. of Krebs' ringer containing 6% dextran and 0.1% of dextrose. Superior cervical ganglion was perfused with this medium by cannulating the homo-lateral carotid artery with polythene tube. For perfusion modified Dale-Schuter's pump was used. The fluid in the delivery tube passed through a water bath and was allowed to enter into the carotid artery and finally into the circulation of the animal, but too much expansion of the animal's circulating blood volume was prevented by bleeding it at intervals, from cannulated external jugular vein.

Unlike the result when mammalian ringer is used as the perfusing medium there was no progressively diminished effect to equal doses of ganglionic blocking drug with lapse of time upto 6 hours or so. As such this preparation gives more consistent and reproducible results and at the same time it very much simplifies the procedure of setting up the experiment.

**41. A method of closed circuit perfusion of isolated mammalian liver using a blood substitute suitable for certain pharmacological investigations.**

J. K. MOHANTY, Cuttack.

The author in course of his work on the pharmacology of methonium compounds worked out this method.

Under ether anaesthesia the abdomen is opened, hepatic artery and common bile duct tied and cut between ligatures. Portal vein and thoracic portion of inferior vena cava is cannulated with polythene tubes; perfusion of the liver through the portal vein is made with an electrically driven perfusion pump. Liver is taken out of the body and put in Ringer bath kept in isothermic condition.

The perfusing fluid is made by suspending 40 vols. of washed human or sheep red cells in 60 vols. of Krebs-Henseleit Ringer containing 6% dextran and 0.1% of dextrose and the pH is adjusted to 7.4. The flask containing the medium from which perfusion is made and into which the venous effluvia drains is kept constantly oxygenated with 95% oxygen and 5% carbon dioxide. Drugs which are metabolised, conjugated or otherwise disposed of by the liver may be added to the medium in known concentration, and venous effluvia collected at varying time intervals and tested to find out the concentration of the drug in each sample.

42. The nature and mechanism of metabolism of Hexa-methonium and its relation to the development of tolerance and cross-tolerance of the autonomic ganglion to methonium compounds.

J. K. MOHANTY, Cuttack.

The author reported that tolerance to ganglion blocking action of methonium compounds follows their administration to intact animals. He also reported that liver is the site of development of tolerance and that it inactivates a substantial part of a given dose of hexamethonium (HMB).

The present paper embodies the results of further studies which throws light as to the nature and mechanism of metabolism of HMB and its relation to the development of tolerance of the autonomic ganglion to such methonium compounds. The results show that intact hepatic cells are not necessary for inactivation or degradation of HMB. A substance is present in disintegrated hepatic tissue which *in vitro* produces inactivation or degradation of HMB. Methods of isolating this substance in fairly pure form have been worked out. Studies on the nature of this liver principle suggested that it is an enzyme, in that alteration in pH, temperature, and the action of certain chemical substances reduced its activity and it is completely inactivated by trypsin digestion. Results of experiments show that the degradation products of HMB produced tolerance and cross-tolerance of the autonomic ganglion to methonium compounds, possibly by competing with the parent substance and allied drugs.

43. The effect of Chlorpromazine on antidiuresis produced by 5-Hydroxytryptamine (Serotonin) in rats.

S. R. DASGUPTA, Calcutta.

Chlorpromazine has been shown to have failed to prevent antidiuresis following either the subcutaneous injection of nicotine or the administration of an osmotic stimulus, thus proving the inability of chlorpromazine to counteract the effect of the centrally liberated A.D.H. This, however, does not give any indication of its effect on the stable antidiuretic substance ("Stable ADS") of serum. Erspamer and Sala having identified the stable ADS as 5-Hydroxytryptamine (5-HT), the present work has been undertaken to study the effect of chlorpromazine on the antidiuresis produced by 5-hydroxytryptamine.

Experiments were carried out by giving water load to a batch of 5 white rats and measuring individually the urine excretion at stipulated hours. Similar experiments were carried out by giving (a) chlorpromazine, 5 mg/kg intraperitoneally  $\frac{1}{4}$  hour before the water load, (b) Serotonin, 40  $\mu$ g/100g. subcutaneously, immediately after hydration and finally (c) chlorpromazine before and serotonin after the hydration. The experiments were repeated with six more batches of five rats each.

It was noted that with water load alone urination usually started within 15-30 minutes and also that 50% or more of the water load was excreted within the 1st 100 minutes. By 240 minutes 80% or more were excreted. With the prior administration of chlorpromazine there was no significant change. The administration of 40  $\mu\text{g}/100\text{g}$  of serotonin produced a very marked reduction in the volume of urine at every scheduled hour. However, the prior administration of chlorpromazine effectively counteracted the antidiuretic action of serotonin.

#### 44. On the standards for Pyrogen.

A. N. BOSE and SRIPATI BOSE, Calcutta.

The biological test for the presence of pyrogen in injectable preparations, as laid down in B.P. or U.S.P. depends on a specified minimum rise of temperature ( $0.6^{\circ}\text{C}$ ) when a suitable dose of the preparation is injected intravenously in rabbits. Absence of a suitable reference preparation for pyrogen precludes any quantitative evaluation of pyrogen in the test material. Under the auspices of the world health organisation two preparations of bacterial pyrogens,—one highly purified from *S. marcescens* and the other, a crude extract from *proteus vulgaris*, were received in this Laboratory in order to see whether any of these could serve as a suitable International Standard for pyrogen. These were assayed biologically to draw out suitable dose-response curves and to test their suitability for pyrogen assay. Tests were performed on in-bred rabbits (1.2-1.5 kg), kept in an air-conditioned room (temperature  $70 \pm 2^{\circ}\text{F}$  and humidity  $55 \pm 5\%$ ). The temperatures were recorded by means of the Hartmann-Brawn apparatus using a series of rectal-thermo-couples operated through a rotary switch. It was found that both the preparations were highly active in minute doses ( $0.025 \mu\text{g}/\text{Kg}$ ). While a graded response could be obtained with different doses,—it was remarkable to note that after a certain range of doses, the pyrogen response went down. Individual variation of the animals to a given dose was also very high. It appears that these preparations can very well serve to check the sensibility of a colony of rabbits for pyrogen test, but quantitative evaluation of pyrogen does not appear feasible as yet.

#### 45. Recent advances in Toxicological analysis.

S. K. CHATTERJI, Calcutta.

1. Classical methods in toxicological analysis will always be the standard methods adopted for general medicolegal purpose.

2. For determination of organic poisons—particularly alkaloids and barbiturates "micro" and "semi-micro" chemical analysis are said to be the first step towards the improved methods.

3. Among the successive developments in the line may be mentioned:

- (a) Biological methods and
- (b) Electrolytic methods.

4. With further advancement the following have been added:—

- (a) Radio Chemical methods.
- (b) Chromatography—either paper adsorption or partition method.
- (c) Ion-Exchange method.

5. Still recently, analysts, in trying to find out quicker and more advantageous methods by recording automatically the results thereof, with full reliability and under economic conditions, devised two important optical methods:

- (a) "Paper Electrophoresis"—by which alkaloids and barbiturates can be separated on filter papers and then eluted in suitable solvents, and
- (b) "Absorptiometric" method either on a visible spectrum or on ultra-violet or Infra-red regions.



Beam of light generated from a Photo-electric Cell is allowed to fall on the unknown substance and the signal produced thereby is magnified and expressed in reference to quantities, which can be recorded graphically on wave length scale.

This has been found to be very efficacious in accurate determination of various compounds—alkaloids or barbiturates.

#### 46. Inactivation of Normal Serum Inhibitors with Trypsin.

D. W. SOMAN and Y. S. NIMBKAR, Bombay.

Normal sera of animals such as those of rabbit, g.pig, ferret and man contain two types of inhibitors which inhibit the agglutination of erythrocytes by different strains of influenza virus thereby affecting the results of the Haemagglutination Inhibition Test (H.A.I. Test) used for typing of influenza strains.

These inhibitors can be inactivated by treatment with crude cholera filtrate,, the preparation and use of which for the H.A.I. Test is more elaborate and time-consuming.

Recently, it has been reported that crystalline trypsin can be used for inactivating these inhibitors in normal animal sera. Experiments, therefore, were undertaken to work out the conditions for tryptic inactivation of inhibitors in normal and immune rabbit sera using locally isolated strains along with standard strains as antigens. Preliminary results show that 28 mg. of trypsin per ml. of serum completely destroyed the inhibiting activity of the serum against all strains used, while a quantity of 4 mg per ml destroyed 25-50% of the inhibiting activity against two locally isolated strains. Under the same conditions, however, no inhibition activity was observed in the normal rabbit as well as homologous immune rabbit serum treated with 4 mg. of trypsin per ml. of serum when a standard W.H.O. antigen and homologous immune rabbit serum supplied for typing purposes was used. It was also observed that a quantity of 8 mg. or more of trypsin per ml. destroyed the specific antibody in the immune serum. The fact that no loss of antibody occurred by treatment with 4 mg. of trypsin was confirmed by testing the serum treated with crude cholera filtrate as control.

#### 47. Incidence of Epileptiform Fits in Syphilis.

K. C. SAHU, Cuttack.

Epileptiform fits in children due to congenital syphilis, though not common are not absolutely rare. This possibility should be borne in mind, when investigating a case of epileptiform. The incidence of fourteen cases, met in three years, among 924 children patients of V.D. Clinic of S.C.B. Medical College Hospital, Cuttack is recorded. Treatment with Penicillin was found to be effective.

#### 48. Skin Tuberculosis and its relation with Pulmonary Tuberculosis.

B. N. BANERJEE, Calcutta.

##### *Synopsis :*

(1) Skin Tuberculosis is not infrequent in this country. Among nearly eighteen thousand people attending a Skin Clinic in a Calcutta Hospital, the percentage of Skin Tuberculosis amongst all cases is 2.5 to 3.0%.

(2) Among 200 cases of Skin Tuberculosis reported here, 45% showed Pulmonary involment also in either lung paranchryma, pleura or glands involvement. The necessity of X-ray examination of chest in all cases of skin tuberculosis is therefore stressed.



(3) Though skin Tuberculosis is usually considered to be due to avirulent type of tubercle bacilli, yet in the series of cases reported here, there were 55 cases of lung affection, 13 cases of pleural, thickening 37 cases of gland enlargement one case of miliary tuberculosis and two cases of meningeal tuberculosis. Quite a number of cases at least were due to virulent types of bacilli.

Skin tuberculosis ought to be taken in such perspective and managed accordingly.

#### 49. Vitamin D<sub>2</sub> in Tuberculosis.

P. K. GHOSH, Calcutta

The effect of a purified product of vitamin D<sub>2</sub> (Sterogyl-15) on the course of tuberculous disease was studied for nine months. The results are summarised as follows :—

(i) On eight chronic, advanced pulmonary cases, it never caused exacerbation or spread of disease, rather it had a slight ameliorating effect. It also did not promote hemoptysis as has been alleged by some authors.

(ii) On 19 gland cases, it has a marked beneficial effect. In nearly 64% of cases, the glands were reduced to less than half their sizes, and in another 31% they regressed definitely but not so remarkably. All the 3 sinus cases in this series were cured in reasonable time.

(iii) In doses of 600,000 i.u. given parenterally and weekly for 4 weeks, and fortnightly for another 8 injections (18 injections in one case) it never produced any toxic manifestations. In the absence of toxic symptoms, later the high dosage was given weekly for 12-14 injections—still no toxic manifestations were noticed. Even in one case in a child of 4 years, 600,000 units in weekly doses did not produce any untoward effects clinically. The toxic effects are believed to be due to other by-products of Vitamin D. Pure Vitamin D<sub>2</sub> (in our experiments, Sterogyl-15 was used) is safe even in high doses.

(iv) Vitamin D<sub>2</sub> in high dose (600,000 i.u.) in human beings did not produce hypercalcemia. In our 44 estimations of blood calcium at different intervals after administration of Vitamin D<sub>2</sub>, the highest rise was 3.3 mg per 100 c.c. only in one case—the mean rise in the 44 cases was 1.3 mg per 100 c.c.

#### 50. A method of desensitization of Allergy due to Streptomycin with Prednisone

SUSHIL CHAKRAVARTY, Calcutta.

In the treatment of Tuberculosis with Streptomycin, allergy due to Streptomycin is about 10% according to Lowell.

Investigations were carried out to desensitize allergy due to Streptomycin. To identify allergy due to Streptomycin, Intradermal skin test with ten milligram (10 mg.). Streptomycin in 0.1 ml. normal saline is done. Out of 150 patients 12 patients were allergic to Streptomycin, Clinically. Of these 12 patients, 11 patients or 90.7 percent reacted to Streptomycin skin test. The rest 138 patients who were not allergic clinically to Streptomycin gave negative reactions to Streptomycin skin test.

Streptomycin skin test is a delayed type of reaction like Tuberculin reaction, which becomes positive in 12-24 hours. To desensitize allergy due to Streptomycin, 50 mg. of Prednisone is given orally daily for one week. After a week, along with 50 mg. Prednisone daily Streptomycin is given intramuscularly, starting with 10 mg. on the first day and doubled daily until reaches the dose of 800 mg. of Prednisone a day. Then the patient is given 1.0 gm. of Streptomycin twice weekly. After

the patient has received Streptomycin 1.0 GM. twice weekly for four weeks, Prednisone is tapered off and stopped, in about two weeks. The patient is given in all, average of 7-8 weeks of Prednisone therapy.

Before stopping the Prednisone therapy every patient is given 20 units of ACTH daily intramuscularly. ACTH is gradually tapered off and stopped in eight days.

In this method four patients of allergy due to Streptomycin is desensitized.

Before desensitizing with Prednisone, both Streptomycin skin test and PPD No. 1 were tested. Out of four patients who were allergic to Streptomycin and later on desensitized, two patients were positive to Streptomycin skin test (50%), one patient could not be tested due to angio-neurotic edema. During Prednisone therapy all of these four cases (100%) were negative to Streptomycin skin test. Four weeks after Prednisone was stopped all of them (100%) were negative to Streptomycin skin test.

Out of four patients who were Allergic to Streptomycin and were desensitized later, three (75%) were positive to PPD No. 1, one (25%) could not be tested due to angioneurotic edema. During Prednisone therapy all of them (100%) were negative to PPD No. 1. Four weeks after Prednisone therapy was stopped, all of the four patients (100%) became positive to PPD No. 1.

This shows that the allergic patients were completely desensitized of the allergy due to Streptomycin in this method, and maintained this state even when Prednisone was stopped for a long time.

#### **51. Ultra-violet Fluoroscopy and its clinical applicability.**

**S. R. MUKHERJEE and BIJON ROY, Calcutta.**

Circulation and blood vascular patterns of various regions in the living body have been studied after intra-venous or intra-arterial injection of the fluorescent dyes. in both animals and humans. These dyes possess the property of emitting visible light when exposed to ultra-violet rays. The intensity of such emission depends on the intensity of radiation of the stimulating wave-lengths in the ultra-violet source, the efficiency of the condensing system and the concentration of the dye in the tissues.

Using sodium fluorescein it has been shewn that the circulation time of the keloid zone is the same as that of the surrounding skin and the fluorescence which gradually increases in intensity unlike the surrounding skin is retained for a longer period with a slower rate of disappearance. With radiation the keloids become avascular.

In the affected limb of Buerger's disease the dye appears late, diffuses less, diffusion time is delayed and that the extent of fluorescence spread is more than the area mapped out by clinical tests of circulatory efficiency.

Presence of active blood flow can be demonstrated in cases of grafts both skin and mucosal.

Vascular patterns in bones after ligating the nutrient artery and also in bones of external, middle and internal ear have been done. These results indicate that by such techniques areas supplied by different sets of blood vessels can be mapped out satisfactorily.

#### **52. Treatment of Yaws and its importance in developmental activities of the village.**

**J. M. SENAPATI, Angul.**

In Bhanjanagar Community Project in the Agency areas near the Daspalla border cases of yaws were detected. In a survey of 39 villages 213 patients were found out of whom 59 were primary yaws, 22 secondary and 132 tertiary. The

patients were disabled as a result of the disease and unable to even cultivate their fields. They were treated with weekly injections of 3 cc of Penicillin in oil with 2% Aluminium Monostearate. Disability disappeared with the treatment and they undertook various developmental work in the village in the shape of digging a new well and taking up improved methods of agriculture. They are very grateful to the project personnel for cure of their disease and along with it their disability.

### 53. Study of air pollution in Calcutta.

M. K. CHAKRABORTY, Calcutta.

With a view to study the problem of air Pollution in Calcutta, a pilot study was conducted for one year. The study is divided in two parts :

- (1) Dust fall collection is made every month from ten representative centres of the city in special dust collecting jars and the total quantity of dust fall per month is estimated in tons per sq. mile. The dust is also analysed for its ash content and volatile matters. The monthly dust fall during the year under study has been found to vary between 30.9 and 131.6 tons per sq. mile.
- (2) Samples of air have been collected and analysed twice every week for  $\text{SO}_2$ ,  $\text{NH}_3$ ,  $\text{NO}_2$  and aldehyde content..

The range of concentration of these gases as found in the study is as follows :

$\text{SO}_2$	...	...	...	...	...	0.01—0.15 PPM
$\text{NH}_3$	...	...	...	...	...	0.08—0.87 „
$\text{NO}_2$	...	...	...	...	...	0.02—0.29 „
Aldehyde	...	...	...	...	...	0.06—0.39 „

## B. VETERINARY SECTION

### 54. Some observations on the clinical and Epizootiological Syndrome of Bovine contagious Pleuro-Pneumonia as it occurs in Assam.

LILARAM BORA, Gauhati.

"Occurrence of Bovine Contagious Pleuro Pneumonia had long been suspected, but recognised only in 1940 in Assam. The paper presents the observations made during the course of a detailed investigation conducted on 26 natural outbreaks of the disease from December, 1951 to August, 1953. Altogether 2,095 Cattle were actually suffering from the disease out of which 2,026 died. Most of the available clinical cases of all the outbreaks were under constant and critical observations and their symptomatological and epizootiological characteristics were recorded.

The technique adopted for collection of seed materials for transmission experiments as well as isolation of organisms in Bennett's Broth are described and the details of the various experiments conducted in the Laboratory are given".

### 55. Control of Bovine contagious Pleuro-Pneumonia in Assam

LILARAM BORA, Gauhati.

Four experiments were conducted with a view to work out and if possible to establish a suitable vaccine locally against Bovine Contagious Pleuro-pneumonia in Assam. In the first a group of eight cattle were inoculated with 0.5 c.c. of seven days' growth of seventh generation Bennett's Broth culture of the strain 3

Assam organisms stored for two weeks at  $-5^{\circ}\text{C}$ . (attenuated culture vaccine) subcutaneously about one inch above the tail-tip. Two out of these eight received also a re-inforcing dose of 1 c.c. of the same material after an interval of about one month. Seven out of eight cattle thus inoculated were subjected to a challenge test—5 on 83rd and 2 on 105th day of vaccination along with a control. All but the control proved solidly immune; the control reacted heavily and died.

The fourth experiment was designed to stage the field trials of the attenuated culture vaccine. Altogether 16 centres were organised under Group "A", "B" and "C" representing the "Clean", "Threatened" and "Infected" zones respectively in almost all the strategic areas in the state. The total number of cattle vaccinated in the Group "A", "B" and "C" was 1,779 and the total number of cattle left unvaccinated in Group "A", "B" and "C" was 1720. The percentage of mortality due to natural B.C.P.P. in combined vaccinated stock in Group A, B and C was 1.74% and in Group B and C only 2.02% whereas the percentage of mortality in combined unvaccinated stock in Group A, B and C was 38.13% and percentage of mortality due to natural B.C.P.P. in the unvaccinated stock of Group B and C only was 43.93%. Group 'B' and 'C' stock were more exact in the study in view of the prevailing outbreaks. These results not only proved that the vaccine was highly effective against the natural disease in the field but also made the vaccine popular amongst the farmers.

Under the Laboratory environment there was no marked reaction and subsequent loss of Tail-tip following vaccination but under field-environment about 1.2% of the total vaccinated stock actually lost their Tail-tip.

The experiment No. 3 was meant to study the Longley's formalised vaccine in regard to B.C.P.P. in Assam but did not yield good result.

The experiment No. 4 was designed to study the use of a crude lymph vaccine against B.C.P.P. under Laboratory condition, the results were not encouraging.

#### 56. Control of Bovine contagious Pleuro-Pneumonia.

LILARAM BORA, Gauhati.

The paper gives an account of the mass vaccination conducted with Attenuated Culture Vaccine i.e. 7th Generation, Strain-3, 7 days' growth Bennett's Broth Culture (Assam Strain B.C.P.P.) stored for about two weeks at plus  $4^{\circ}\text{C}$ , over 65, 709 cattle in Assam irrespective of age, Sex and Breed during the period from May, 1953 to March, 1955. The vaccination was done in the strategic districts and is proving considerably successful in the control of Bovine Contagious Pleuro Pneumonia in the State.

During the course of this observation, on mass vaccination, incidences of minor importance such as loss of Tail Tip or death of animals following vaccination were also experienced. But such incidents were indeed very very rare. Other measures adopted in the field for speedy control of the disease are also mentioned.

#### 57. Studies on some aspects of Prophylactic vaccination for Haemorrhagic Septi-

D. KRISHNA MURTHY, Mathura.

Haemorrhagic Septicaemia is one of the most important disease causing annually a recorded mortality of over 7,500 animals amounting to a financial loss of over four lakhs of rupees. Being a seasonal disease occurring mainly during the monsoon period, the effects of this disease are very pronounced on the agricultural operations carried out during this period, thus leading to considerable losses in agricultural production of the State. Prevention and control of this

disease is still a vexatious problem and continuous efforts are being made to improve the present methods of prophylactic vaccination practised in rural areas.

Experimental studies were conducted with three vaccines 'composite broth vaccine', agar washed vaccine and oil adjuvant vaccine in order to assess and compare the post-vaccinal reactions and duration of immunity produced by them. With a view to ascertain the improvement in the period of immunity produced by double vaccination, certain number of animals were vaccinated with agar-wash vaccine twice at an interval of one month. From these studies it is evident that the period of immunity produced by the oil adjuvant vaccine is more than the other two vaccines and lasts for 124 days after which it wanes off. Agar-wash vaccine administered by two injections will afford satisfactory immunity for a period of 98 days while the other two methods will not set up immunity even for a period of three months. There is no fall in milk yield as a result of these vaccinations and there is no thermal reaction. A few animals vaccinated with agar-wash vaccine are likely to develop symptoms of shock immediately after vaccination. Oil adjuvant vaccine, in view of its thick and only consistency, is rather difficult to use under field conditions and wider bore needle is necessary for inoculation. A persistent local nodule is likely to result if any portion of this vaccine goes into the subcutaneous tissue. Other observations made during these experimental studies have also been recorded.

**58. Intestinal myiasis in a duck caused by the larvae of *Musca* sp.**

C. T. PETER, Izatnagar.

Out of three ducks purchased from a local dealer and kept in the laboratory for more than four months, one was found dead in its cage before it was made use of for any experimental purposes. The bird showed extreme weakness and was off feed for two days prior to its death. At autopsy, 17 live maggots were recovered from the intestine near the rectum, and they were all identified as those of *Musca* sp. Apart from an acute inflammation of the intestinal mucosa throughout its length with slight haemorrhage and a stasis of the gut contents, no other abnormalities could be detected.

It is thought that the larvae entered into the gut through the cloaca after hatching out from fly eggs that were deposited in close association with the bird while it was alive. In the absence of any other aetiological factors, the death of the duck is attributed to intestinal myiasis.

**59. A record of *Globidium leuckarti* (Flesch) from a horse in India.**

L. S. HIREGAUDAR, Bombay.

*Globidium leuckarti* has been recorded from a horse at Mangrol (Bombay State) for the first time from India. The oocysts of *G. leuckarti* are of Eimeria type, large, 84×58 microns, deep brown in colour and oval in shape. Sporulation time is 15 days. The genus *Globidium* has been uncertain for many years. Reichenow (1940) lists *Globidium* as a subgenus and there is a great deal of justification for this treatment.

**60. Preliminary note on etiology so called "Bursati Lesions" in cattle in Bengal.**

B. DUTT, Izatnagar.

Histopathological studies were carried out on the skin tissues from the skin lesions over the legs, feet etc. found in cattle in Bengal. These skin lesions are named as "Bursati", "Dum-Dum sore" or "Calcutta sore". Histopathological

examination of skin tissues revealed the presence of a section of nematode worm beneath rete malpighi and marked eosinophilic infiltration in the dermis. At places in the dermis, eosinophiles had aggregated together and gave the appearance of eosinophilic granuloma. Earlier Menon (1934-35) had found filaria in dehaemoglobinised thick smears from such lesions found on legs, feet etc.

It is, therefore, held out that perhaps the same agent which causes hump sore (*Stephanofilaria assamensis*) as reported by Pande (1935) may be responsible for the skin lesions in Bengal cattle which are named "Bursati", "Dum Dum sore" or "Calcutta sore".

**61. On a new oxyurid, *Syphacia srivastavi* n.sp. from pig, *Sus cristatus* in India.**

P. K. SINHA, Calcutta.

While studying the incidence of helminths in Pigs in Bareilly, a new species of oxyurid was recorded from the stomach of pigs. Two animals were found infected with the nematode and in both the cases only female worms were recovered. No male worm was detectable. In all six specimens were collected intact and the descriptions and measurements are based on these specimens.

The present species is the first record of *Syphacia* from pigs. It is interesting to note that all *Syphacia* species have so far been recorded from the large intestine of their host whereas the present species is found in the stomach of pigs.

Twenty-one species of *Syphacia* have been described so far some of which may prove to be synonymous. Of all the species *S. srivastavi* has the greatest affinity for *S. bonnei* and *S. obubra*. By the larger size of the worm, relatively very long oesophagus and the more complex structure of the anterior end. *S. bonnei* can be easily distinguished from the present species. The anterior end of the female of *S. obubra* is also very complex and the eggs are larger compared to those of *S. srivastavi*.

**62. On a new cestode, *Raillietina* (*Raillietina*) *dattai* n.sp. from poultry *Gallus gallus domesticus* in India.**

P. K. SINHA, Calcutta.

Some specimens of cestodes collected from a hen of the Government Poultry Farm, Patna were found to be a new species. Out of the eight specimens all of which belonged to the same species only six were complete.

The present species has the greatest affinity for *Raillietina* (*Raillietina*) *volzi* of fowl which has been recorded also from India. *R. (R.) dattai* can be readily distinguished from *R. (R.) volzi* by the shape of the cirrus sac only. The hour-glass shape of the cirrus sac is not found in any other known species of this subgenus.

**63. Observations on the post-cercarial development of *Echinostoma revolutum* (Froelich).**

C. T. PETER, Izatnagar.

In India, the life-history of *Echinostoma revolutum* has not been previously worked out, though its adult and cercarial stages are known to exist. An echinostome cercaria obtained locally from aquatic snails of the species *Limnaea luteola* f. *succinea* was found to resemble *Cercaria echinostomi revoluti* Beaver in its general morphological features, especially in the collarspination which agreed with that of the adult stage of the fluke under study. Its relationship to *Echino-*

*stoma revolutum* has now been experimentally established by raising adult specimens of the fluke in birds. Details of the observations made on the post-cercarial development of the parasite are dealt with in this paper.

Various species of aquatic snails were found to serve as second intermediate hosts of the parasite. Experimentally-raised metacercariae when fed to ducks and chicks developed in from 18 to 21 days into trematodes which were referable to *Echinostoma revolutum* (Froelich). In pigeons, heavy experimental infection with this fluke proved fatal, and the birds died before the worms attained maturity.

#### 64. On the occurrence of *Orientobilharzia turkestanicum* in cattle in India.

H. D. SRIVASTAVA and K. N. TRISAL, Izatnagar.

The largest number of species of blood-flukes occurring in any one country in the world are found in India. Apart from the bloodflukes parasitic in Indian reptiles and birds, the species which have been known to infect domesticated mammals in this country are: *Schistosoma indicum*, *S. spindale*, *S. incognitum*, *S. nasale*, *Bivitellobilharzia natri*, *Orientobilharzia dattai* and *O. bomfordi*. The reported occurrence of *S. bovis* in India needs confirmation. Besides the recorded occurrence of about a dozen autochthonous cases of urinary schistosomiasis and a few of intestinal form in human beings in India, an endemic focus of urinary schistosomiasis due most probably to *S. haematobium* in human beings has recently been discovered in village Gimvi in Ratnagiri district. In this paper is reported the occurrence in India of yet another unrecorded species of bloodfluke.

The parasite was originally described as *Schistosomum turkestanicum* by Skrjabin in 1913 from the portal veins of local cattle in Russian Turkestan. Price, 1929, transferred the species to the genus *Ornithobilharzia* and Dutt and Srivastava, 1955, have assigned it to *Orientobilharzia*. The parasite is known to occur in several countries, and has been recorded from sheep, goat, cattle, buffalo, camel, horse, donkey, mule and cat. In India two outbreaks of infection of this parasite among cattle have been investigated. In both the outbreaks the mortality among the infected cattle was quite high. The faeces of the affected animals contained numerous eggs characteristic of the species and a large number of adult male and female specimens of the parasite was recovered on post mortem examination.

#### 65. A study of the blood of Goats.

A. N. GUHA and A. CHATTERJEE, Calcutta.

The blood of 32 goats of the Jamunapari breed, imported in Calcutta were studied. The morphology was studied both in fixed preparations and under Supravital staining. The following values were obtained:—

R.B.C. in million	$-12.05 \pm 1.55$ per cmm	Eosinophils	$1.5 \pm 0.5$
W.B.C. in thousand	$-11.1 \pm 1.3$ "	Basophils	0
Lymphocytes	$-39 \pm 5\%$	Haemoglobin gm%	$11.1 \pm 1.1$
Polymorphs.	$50.5 \pm 5\%$	Haematocrit	$33 \pm 5$
Monocytes	$7.5 \pm 2.5$	Specific gravity	$1.0375 \pm 0.0025$

#### 66. Occurrence of Tropical Eosinophilia like disease amongst Cattle in India.

A. N. GUHA, Calcutta.

Studies on 20 cases of nonspecific eosinophilia in cattle, somewhat similar to tropical eosinophilia in human have been recorded in this paper. The animals exhibited the symptoms of anorexia, dry persistent cough at night followed by



expiratory dyspnoea in the morning, râles and wheezing sound during expiration on auscultation. Differential count of blood showed increase in the number of Eosinophils. While the normal eosinophilic count of Indian Cattle varied from 3-10%, these animals showed a rise upto  $24.5 \pm 7.5\%$ . Sex factor did not play any part in these animals and it was observed that animals below six years of age were not infected. After 2 injections of Acetylarson the eosinophilic count increased upon  $33.5 \pm 5.5\%$  but after some more injections came down upto  $8.5 \pm 1.5\%$ . All the cases recovered by the 4th week.

**67. Oral administration of insecticides for ectoparasite control and their toxicity to the hosts.**

P. BALARAMA MENON, Izatnagar.

In continuation of experiments reported previously laboratory bred white rats dosed with DDT and gamma-BHC at the rate of 500 mg. kg. body weight and 250 mg/kg body weight respectively on two successive days gave 60 to 100 per cent mortality among ticks, *Argas persicus* (Oken), allowed to feed on them on the first two days, but batches of ticks fed on the eighth day after drugging gave only 16 to 17 per cent mortality showing thereby that the drugs did not remain effective in the circulation for a period of eight days to give a satisfactory kill. Mosquitoes, *Culex fatigans* Wiedemann, bred out in the laboratory and 48 to 72 hours old, fed on these rats on the second night of drugging, all died within 24 to 48 hours after taking their blood meal.

Observations on the oral toxicity of these insecticides to white rats showed that DDT and gamma-BHC in single doses of 500 mg./kg. body weight or in two doses of 250 mg./kg. on successive days were tolerated well by the rats without showing any ill effects. Chlordane was not tolerated in doses of 1000 and 500 mg./kg. body weight as the rats died on the day following the administration of the drug.

**68. Semifield trials with some modern insecticides for controlling lice infestation on livestock.**

R. P. CHAUDHURI and PAVAN KUMAR, Izatnagar.

Lindane, Paralac (containing dieldrin) and DDT killed 100% lice *Haematopinus tuberculatus* on buffalo calves and kept the latters free from lice for 28, 18, and 7 days respectively. Similarly dieldrin, chlordane, lindane, DDT, malathion, diazinon and Paralac freed cow calves completely from louse *Linognathus vituli* but re-infestation started one and two weeks after treatments on calves treated with malathion and the rest of the insecticides respectively. DDT, lindane, toxaphene, chlordane, rhothane, aldrin, dieldrin, Paralac, malathion and diazinon killed completely all lice *Linognathus stenopsis* and *Damalinia caprae* on goats. In the winter trials re-infestation started on goats treated with DDT and diazinon 4-5 weeks after treatments and on those treated with lindane 3-4 weeks after treatments, whereas toxaphene and Paralac gave complete control of lice only for one and two weeks respectively. However, in the summer trials any of these 10 insecticides kept goats louse-free for 9-10 weeks. Goats treated with DDT, rhothane and aldrin showed re-infestation after 11 weeks and all others except those treated with dieldrin and chlordane began harbouring lice only after 13 weeks. Dieldrin and chlordane gave absolute protection to goats at least for 14 weeks. Biting lice infestation developed much slower than sucking lice infestation on treated goats.



**69. Histo-pathological studies in rats fed with Argimone Oil.**

B. DUTT and D. N. MULLICK, Izatnagar.

Six groups of four growing albino rats were selected. One group was kept on control diet and the other five groups were fed with 0.5, 1, 2, 4 and 8 per cent. Argimone oil along with good diet. After nine months of feeding the rats were destroyed and histopathological studies of the tissues obtained from such rats were carried out.

The only conspicuous and constant pathological change was observed in the testes of rats receiving 1 per cent Argimone oil and above. Testes of such rats showed degenerative changes of seminiferous tubules surrounded by fluid giving the appearance as if the seminiferous tubules were floating in liquid. Spermatogenesis was greatly reduced.

**70. Some studies on the Pharmacological Actions of the Patharkuchi leaves.**

A. K. CHOWDHURY and B. B. PAL, Calcutta.

A preliminary study of the Pharmacological actions of Patharkuchi leaves was taken up as regards its action on the plain and cardiac muscles and on blood coagulation. It was seen that in the crude water extract of the Patharkuchi leaves there are certain principles which have a very significant action on the plain and cardiac muscles of mammals and amphibians respectively. The drug was seen to have a stimulating action on the cardiac and intestinal muscles. There was a significant increase in the tonus contractility and irritability of these muscles. The drug also seems to have some influence on the parasympathetic nerve endings which are first depressed followed by a secondary stimulation. The drug was seen to have a remarkable effect on blood coagulation and effective both in vitro and in vivo experiments indicating the possibility of the drug for use as a cheap haemostatic.

**71. Cobalt content of feed from different farms in India.**

S. N. RAY and A. W. ZUBAIRY, Izatnagar.

The cobalt content of feeds from several farms situated in different parts of India has been analysed. The concentration of this mineral in p.p.m. (on dry basis) in the feeds varied from 0.056 to 0.17. On the basis of these figures, it appears that acute cobalt deficiency is not likely to exist in the animals of these farms.

**72. Effect of feeding Linseed (*Linum Usitatissimum*) Cake pressed by different methods of growth rate.**

N. D. KEHAR, P. C. SAWHNEY and P. T. VARANDANI, Izatnagar.

In a previous publication observations on the effect of feeding sarson (*Brassica campestris*) cake prepared by different methods on the growth rate and digestibility of proximate principles in calves were reported. Similar studies were made using linseed cake in place of sarson cake. The concentrate mixture fed to three comparable groups consisted of 50 parts linseed cake, 25 parts barley, 12.5 parts wheat bran and 12.5 parts oats. The linseed cake used in the three groups was ghani pressed, expeller pressed and solvent extracted respectively. The experimental observations were carried out for 46 weeks.

The gain in weight and final weights of the calves in the three groups did not show significant variation. These findings confirm those of previous experiment with sarsoon cake, that the rate of growth is not affected by feeding oil cakes with different fat levels due to method of preparation.

A metabolic trial was conducted and it was found that the total digestible nutrients ingested per 100 lbs. body weight were 830, 906 and 896 gms. per day for solvent extracted, expeller pressed and ghani pressed cake groups respectively.

**73. Studies on the Nutritive Value of Linseed (*Linum Usitatissimum*) Cake prepared by ghani expeller and solvent extraction process.**

N. D. KEHAR, M. L. MATHUR and B. SAHI, Izatnagar.

Since considerable controversy exists as to the possible effect of feeding resultant cake produced by solvent extraction process as compared to cake produced by ghani and expeller process, experiments were, therefore, planned to study the comparative nutritive value of the ghani, expeller and solvent extracted linseed cakes. The cakes were fed to 3 comparable groups of adult Kumaoni bullocks to meet their digestible crude protein requirement and wheat bhoosa was fed as the sole roughage to all the animals. The rations were fed for one month and during last ten days, a metabolic trial was conducted.

The total digestible nutrients of rations per 100 lbs. dry matter containing ghani, expeller and solvent extraction process were 48.74, 49.24 and 47.33 respectively.

The digestible crude protein per 100 lbs of dry matter for solvent extracted, expeller pressed and ghani pressed linseed cakes was found to be respectively 27.83, 24.55 and 24.64.

The balances for nitrogen were positive in all the groups while for those of calcium and phosphorus were slightly negative in solvent extracted cake group and positive in the other two groups.

**74. Effect of feeding (I) Cotton Seed (II) Cottonseed Cake on the digestibility of proximate principles, Milk yield and Fat production in cows.**

N. D. KEHAR, K. SAHAI, M. L. MATHUR, P. C. SAWHNEY, B. C. GUPTA, K. NATH, P. N. JOHRI and P. T. VARANDANI, Izatnagar.

Cotton seed is one of the important oil seeds produced in India, its annual production being estimated at about one million tons. The seeds and the cake produced by extracting the oil are used extensively for feeding cattle. In this article, the results obtained in the three experiments conducted to study the effect of feeding cotton seed cake as compared with one another and also with a control dairy mixture, on the digestibility of proximate principles, milk yield and fat production in cows are given.

Experimental observations were conducted on three similar groups of Haryana cows comparable as regards age, number and stage of lactation and of milk and fat yield. Group I was kept as control and was fed on a dairy mixture consisting of barley, linseed cake and gram husk. In groups II and III, 50 per cent of the digestible crude protein was replaced by cotton seed and cotton seed cake respectively. Roughage fed was the same in all the groups.

In order to get an over all picture the results of the 3 experiments were pooled and it was noticed that (a) the digestibility of ether extract showed a trend being highest in cotton seed group followed cotton seed cake and dairy mixture groups in a descending order. The differences were found to be significant only in 2 out of

3 experiments. The digestibility of crude protein and total carbohydrates did not show any particular trend. The variations in the digestibility were significant in 2 out of 3 experiments in case of crude protein and only in one experiment in case of total carbohydrates.

(b) Data on milk yield and fat production of the 3 experiments when pooled to get an over all picture showed an actual but not significant increase in total fat production in cotton seed group as compared to other 2 feed groups, whereas values for milk yield and FCM were lowest for cotton seed group and highest for cotton seed cake group. The differences again were not significant.

**75. A Study on the feeding effect of Aureomycin in Calves.**

D. N. MULLICK, Izatnagar.

Sixteen male calves of fourteen to sixteen weeks old were divided into 4 groups of 4 animals each. The control calves were fed with normal ration and the three experimental groups received in addition to their standard ration, a supplement of 10 mg., 30 mg. and 90 mg. of aureomycin per 100 lb. live weight.

During the period of observation extending over 13 weeks, weekly body weight and heart girth measurements were taken. The blood was analysed weekly for hemoglobin and total leucocyte counts. The faeces was examined for parasitic infection for fortnightly intervals.

Results showed that though the experimental groups recorded slight increased rate of growth, the pounds of feed per pound of gain in body weight were same in all the groups.

The treated animals showed no digestive trouble and they had less number of works in faeces in comparison to control.

The addition of 30 mg. of aureomycin in the ration of calves had most beneficial effect on the animals for the maintenance of health and control of diseases.

**76. Inheritance of loose horns in cattle (Kapila).**

M. P. JOHARI, Mathura.

The character of having loose horns (Kapila) is genetically determined. It is a recessive character and is located on autosomal chromosomes. The character is linked up with milk production and so has a great economic significance. The character has been recorded in Haryana, Sahiwal and Gangotri breeds kept in Uttar Pradesh.

**77. 'Heelnan' (Shaking)—a new hereditary disease in Haryana cattle.**

M. P. JOHARI, Mathura.

'Heelnan' or the disease 'neuro-muscular irritability' seen in Haryana cattle, is hereditary. Preliminary findings are that it is autosomal and is likely to be dominant with low penetrance.

**78. A new hereditary malformation of the sex organs in buffalo bulls (*Bubalus bubalis*).**

M. P. JOHARI, Mathura.

A hereditary anatomical deviation of the testicle in a water buffalo is described. The mutation appears to be dominant and it does not influence the general health or breeding efficiency of the bull.

**79. Studies on Sex Hormones—Part V—sperm test of pregnancy in the diagnosis of Bovine Gestation utilizing the aqueous extract of faeces of the animal.**

J. K. MOHANTY, Cuttack.

Aqueous extract of faeces cows known or suspected to be pregnant was injected to male toads, *Bufo melanostictus* Schneid. 36 samples of faeces from 30 animals were tested. There was no false positive or false negative results with this series. The speed of reaction was somewhat slower compared to that with human pregnant urine. Use of a small quantity of hyaluronidase shortened the time of sperm ejaculation. Concentration of the extract did not influence the speed of reaction but it decreased the quantity of extract injected for positive reaction. The sperm ejaculating properly alone of the substance present in the faeces of pregnant cow however does not establish its gonadotrophic nature. Its true gonadotrophic activity still remains to be proved, for which work is in progress.

However this biological test is simple, rapid and economical and as such commends itself for wide use.

**80. Studies on reproductive efficiency in Donkey mares.**

M. L. KOHLI and K. R. SURI, Hissar.

A study of 694 foalings of 128 donkey mares from stud of the Government Livestock Farm, Hissar during the period from 1916 to 1954 showed that the services required per conception and the fertility rate for the first foaling did not differ significantly from the post-partum foalings. A mean of 2.1 services were required per conception and the average fertility rate of the stud was 47.2 per cent. The conception rate of foal heat was poorer than those bred at later dates. Fertility rate was highest for the period between 49-79 days after foaling. The foaling percentage did not vary from month to month. The average post-partum period for fertile service was  $162.49 \pm 6.67$  days.

**81. Studies on the gestation length and breeding age in Donkey mares.**

M. L. KOHLI, K. R. SURI and A. CHATTERJI, Hissar.

A study of 640 gestation periods of 128 donkey mares of the Government Livestock Farm, Hissar during the period from 1916 to 1954 showed that the average gestation length was  $374.43 \pm 0.25$  days.

The gestation period was slightly longer ( $374.86 \pm 0.81$  v.  $373.98 \pm 0.73$ ) for males than for females. For male foals, the longest average gestation period occurred in March and for female foals in February. The shortest average gestation period for males was in September while for females in June. The month of foaling and the sire had a significant effect on the gestation period. The average age for first service was  $42.46 \pm 0.85$  months and the average age for first foaling was  $59.67 \pm 1.09$  months.

**82. Factors affecting Birth weight in Haryana cattle.**

M. L. KOHLI and K. R. SURI, Hissar.

The data were taken from the Haryana herd, bred and raised at the Government Livestock Farm, Hissar from 1946-53. 771 birth weights of calves were studied. It was observed that bull calves, on an average, were significantly heavier than females. Calving sequence of the dam, the season of freshening and the sire had no significant effect on the birth weight of the calves.

**83. Longevity and reproductivity in Haryana cattle.**

M. L. KOHLI and K. R. SURI, Hissar.

A study of the ages of 1917 Haryana cows and 28 Haryana stud bulls, extending over a period of 15 years and 18 years respectively showed that the mean age at which the cow first freshened was found to be  $58.83 \pm 0.20$  months. The average re-productive life of a cow was  $80.70 \pm 0.90$  months. The average number of calvings during the life time of a cow was  $4.67 \pm 0.11$ . The average life of the cow was  $136.30 \pm 0.95$  months and that of the bull was  $98.1 \pm 4.6$ . The maximum age recorded for the cow and the breeding bull was 18 years 9 months 7 days and 15 years 9 months 21 days respectively. The highest mortality in the herd was due to tuberculosis and most of the cattle between the ages 7 to 10 years died of other non-contagious diseases.

**84. Factors affecting gestation length in Haryana cattle.**

M. L. KOHLI and K. R. SURI, Hissar.

The study was based on the data collected from a herd of Haryana cattle, a 'dual purpose' breed (milk and draught) of the Government Livestock Farm, Hissar for a period of 8 years i.e. from 1946-53 on 797 parturitions. The average length of gestation period was  $290.7 \pm 0.9$  days. Male calves were carried to a significantly longer period of time than females. The sequence of calving, month of freshening, sire and sex had a significant effect on gestation period. There were positive correlations between the body weight of the dam and the birth weight of the calf with the gestation period. No significant correlation was observed between the dry period of the cows and the gestation.

**85. Relationship of the postpartum Breeding interval to reproductive efficiency in the Haryana cow.**

M. L. KOHLI and K. R. SURI, Punjab.

A study of 576 normal calvings in an experimental herd of 271 Haryana cows from 1945-54 showed that the appearance of heat after calving was late and the interval was  $230.2 \pm 4.9$  days: 1.4 services were required per conception over the entire period of about 12 years. The percentage of total conceptions resulting from first service was 72.8. A minimum interval from calving to first service of 100 days was required for satisfactory fertility.

**86. The relation of some factors to the occurrence of post-partum oestrus in Haryana cattle.**

M. L. KOHLI and K. R. SURI, Punjab.

A study of 538 parturitions in 271 Haryana cows of the experimental herd at the Government Livestock Farm, Hissar showed that the average length of interval from parturition to the first oestrus was found to be  $228.0 \pm 3.9$  days. The month and season of the year seemed to affect the length of the post-partum interval to first oestrus. The season of calving also affected the interval. There appeared no relationship between the average daily milk yield and the interval between calving and first oestrus. The age of the cow and lactation number were observed to influence the interval from calving to first oestrus.

**87. Cytochemistry of Buffalo Bull spermatozoa.**

A. K. CHOWDHURY, B. B. PAL, and A. N. CHAKRABARTY, Calcutta.

The cytochemical reactions of the buffalo spermatozoa were studied using most modern cytochemical procedure. It was found that the cytochemical reaction of buffalo spermatozoa are almost identical with those of the bull spermatozoa. The buffalo spermatozoa of course showed a much feeble reaction to acid and alkaline phosphatases compared with those obtained in the bulls. The sudan black B positive material and peroxidase positive materials were seen to be located chiefly in the middle piece of the spermatozoa. Iron haematoxylin method stained the sperm head only, quite intensely but the middle piece and tail remained negative. The reason for comparatively feeble reaction obtained in acid and alkaline phosphatases is probably due to comparatively lesser amounts of these enzymes located in the spermatozoa.

**88. Transportation of cow bull semen by rail.**

S. K. SAHA and R. B. SINGH, U.P.

The cow bull semen was transported 11 times in different preservatives to select the best dilutor for the despatch of semen to long distances. The result on the transportation of cow bull semen to distances over 150 miles in egg-yolk sodium citrate, mixture of egg-yolk sodium citrate and glycine and egg-yolk glycine indicates that there is little difference between the keeping quality of the semen in these preservatives.

The transported semen in egg-yolk sodium citrate dilutor maintained the motility up to +3 for an average period of 3.0 days, in the mixture of egg-yolk sodium citrate and glycine for an average period of 3.9 days and in the egg-yolk glycine for an average period of 4.1 days where as the controls maintained in the laboratory in these dilutors could maintain upto +3 motility for 5.2 days, 10.1 days and 7.6 days on an average respectively.

The semen in these dilutors under transportation could survive for an average period of 7.6 days, 8.9 days and 8.0 days respectively where as the controls without transportation could live for 14.2 days, 18.3 days and 15.1 days respectively.

**89. Mixture of egg-yolk Sodium Citrate and Glycine as dilutor for ram semen.**

R. B. SINGH and S. K. SAHA, U.P.

Ram semen was preserved at 4°C in the mixture of egg-yolk sodium citrate and glycine. The efficacy of this diluent was compared with that of egg-yolk sodium citrate and egg-yolk glycine. The composition of the dilutors were as follows :—

1. Mixture of egg-yolk sodium citrate and glycine (a solution of 1.8% sodium citrate and 2% glycine, mixed with equal volume of egg-yolk).
2. Egg-yolk glycine (4% glycine with egg-yolk in equal volumes).
3. Egg-yolk sodium citrate (3.6% sodium citrate and egg-yolk in equal parts).

The mixture of egg-yolk sodium citrate and glycine was found to be the best amongst all the dilutors used for the preservation of ram semen samples. It can be used for insemination in this dilutor for an average period of 17.2 days and the sperms live for an average period of 27.14 days. The longest sperm survival in this medium was of 54 days. The next best diluent is egg-yolk glycine in which the life for insemination was 8.0 days and the average sperm survival was for

15-14 days. The longest period for which the sperm could survive in this diluent was of 28.0 days. The average life of semen in the egg-yolk sodium citrate for insemination purpose was for 4.4 days. The longest period of sperm survival of one of the samples in this medium was for 22 days and the average sperm life was for 13.42 days.

**90. On the epidermal structures of the miracidia of six species of mammalian schistosomes and a new technique of specific diagnosis of animal schistosomiasis.**

S. C. DUTT and H. D. SRIVASTAVA, Izatnagar.

The epidermal cells and extra cellular papillae of the miracidia of *Schistosoma indicum*, *S. spindale*, *S. nasale*, *S. incognitum*, *Orientobilharzia dattai* and *Bivittellobilharzia nairi* have been studied. The miracidia of all these species possess, in the vast majority cases, twenty-two epidermal cells arranged in four tiers of six, nine, four and three cells respectively. *S. indicum*, *S. spindale* and *S. nasale* possess six sets of papillae, while *S. incognitum*, *O. dattai* and *B. nairi* possess five sets. The first set is situated at the base of the tenebrarium and consists of two groups of nine papillae each. The second set consists of six papillae, each of which is situated at the middle of the base of each epidermal cell of the first tier. The third and fourth sets are situated in the space between the first and second epidermal tiers. In *S. indicum*, *S. spindale* and *S. nasale* the third set contains two papillae, one on each lateral aspect; while in *S. incognitum*, *O. dattai* and *B. nairi* it contains four papillae, two on each side. In *S. indicum*, *S. spindale* and *S. nasale* the fourth set contains six papillae, three on each side; while in the other three species the number is larger, being 18-21 in *S. incognitum*, 14-17 in *O. dattai* and 34-38 in *B. nairi*. The fifth and sixth sets are situated in the space between the second and third epidermal tiers. The fifth set contains two small papillae, one on each side. The sixth set, absent in *S. incognitum*, *O. dattai* and *B. nairi*, contains 15-20 papillae in *S. indicum*, 20-22 in *S. spindale* and 23-25 in *S. nasale*. Six of the papillae of the first set appear to be sensory and the other three glandular. The two marginal papillae of the second set are the so called "lateral papillae" and those of the third set are the so called "anterior ducts" or "lateral processes". The papillae of the fourth and sixth sets bear stiff bristle-like sensory cilia.

Specific diagnosis of animal schistosomiasis can be made on the basis of the number of papillae on the third, fourth and sixth sets. The epidermal structures are best revealed by the vital staining and silver impregnation techniques.

**91. On the susceptibility of equines to infection with *Schistosoma spindale*.**

S. C. DUTT, Izatnagar.

*Schistosoma spindale* is known to infect many species of domestic animals, but so far it has not been reported from equines. To determine the susceptibility, a year-old foal was infected by the oral route with about 71,000 cercariae of *S. spindale* shed by twenty naturally infected *Indoplanorbis exustus*. The faeces of the animal remained negative for the ova of the parasite upto the 14th month following the infection when it died of colic. On post-mortem the liver was found to contain a large number of pseudotubercles in which the shells of *S. spindale* ova could be recognized. About 300 adult specimens of *S. spindale* were recovered from the mesenteric and portal veins. The proportion of males to females was nearly 4:1. All the worms were mature but the females were comparatively much



smaller and ill-developed. Though most of the females contained apparently normal ova in the uterus, not a single mature ovum was found in the tissues, indicating that there was no further development after oviposition. This probably accounts for the non-appearance of ova in the faeces. This experiment indicates that in nature *S. spindale* may infect equines, but the infection cannot be detected as the ova are not passed out with the faeces.

## 92. Studies on the transmission of surra by arthropods.

R. P. CHAUDHURI, Izatnagar.

Surra transmission experiments have been carried out by using a number of different kinds of arthropods associated with livestock in this country. Guinea pigs and rats have been used as experimental animals. Aim of the study has been mainly to see if these arthropods transmit the disease and to throw some light on the mechanism involved in the act of this transmission. In the result so far none of the ticks *Ornithodoros savignyi* Aud., and *Hyalomma savignyi* (Gerv.), flea *Ctenocephalides* spp., Ox louse *Linognathus vituli* (Linn.) and stable fly *Stomoxys calcitrans* (Linn.) has transmitted the disease. Buffalo louse *Haematopinus tuberculatus* (Burm.) has shown the capability of transmitting it sometimes. However most of these arthropods have been found to have imbibed *Trypanosoma evansi* (Steel) into their gut along with blood meal from surra affected animals and the flagellate remains alive and viable inside their gut as long as the ingested blood remains in the liquid form, i.e. only for a few hours. No other organ inside the arthropods has shown any sign of presence of the flagellate. Results indicate that the transmission by buffalo lice is effected by the external contamination of their mouth-parts with *T. evansi*.

## 93. Antagonism of the action of Antrycide in experimental 'Surra'.

H. G. SEN and H. N. RAY, Calcutta.

The mode of action of chemotherapeutic drugs acting as anti-metabolites by blocking the normal enzyme systems of cells was first, elucidated by the work of Woods (1940) who showed that the therapeutic action of sulphonamides both *in vitro* and *in vivo* in different bacterial infections was antagonised by p-amino-benzoic acid. This antagonism was also demonstrated against a number of plasmodial infections, *P. gallinaceum* (Maier and Riley, 1942; Bishop and McConnachie; 1948), *P. knowlesi* (Richardson *et al* 1946) and *P. berghei* (Thurston, 1954).

It has also been demonstrated in trypanosomiasis that administration of sulphhydryl compounds such as cystein, glutathione and BAL, reversed the therapeutic activity of arsenicals. Attempts were thus made to antagonise the action of antrycide in *Trypanosoma evansi* infection in rats by administration of sulphhydryl compounds such as methionine, cysteine and glutathione.

Three sets of experiments were carried out with each of the above sulphhydryl compounds. Methionine (30-90 mgm.), cysteine hydrochloride (30-90 mgm.) and glutathione (30 mgm) were administered daily simultaneously to groups of infected rats treated with a single dose of antrycide (3 mgm./kg. body wt.) by sub-cutaneous route. The density and the survival period of the trypanosomes were much higher in these groups as compared to rats treated with antrycide alone. In the groups receiving antrycide plus the —SH group compounds in the first 36 to 48 hours the localisation of the enzyme alkaline phosphatase was almost similar to the normal ones and the amount of mucopolysaccharides appeared to be less than those seen



in the flagellates treated with antrycide alone. After 48 hours the trypanosomes treated with antrycide and methionine were found affected and usually disappeared in 72 to 96 hours and in few cases in 120 hours in contrast to the control experiment which took usually 48 hours.

From the above observations it is suggested that administration of excess-SH compounds such as methionine, cysteine or glutathione produces a temporary stimulating effect on the growth of trypanosomes during the first 48 hours but once the trypanocidal activity is established, it cannot be reversed by administration of any of the above compounds.

**94. Studies on the life history and habits of the fowl tick *Argas persicus* (Oken) under Indian condition.**

R. P. CHAUDHURI, Izatnagar.

Life history and habits of the fowl tick *Argas persicus* (Oken) have been studied in the laboratory at Indian Veterinary Research Institute, Izatnagar. Egg incubation period of the tick is 6–10 days. Larvae start feeding when about 4 days old and take 4–5 days to engorge. Unfed larvae live for 7–21 days. Repleted larvae retire for 3–8 days before moulting. 4–5 days after 1st moulting 1st nymphal feed is started and it lasts 10–20 min. First instar nymphal stage is about 6–8 days. 7–15 days after 2nd moulting 2nd instar nymphs feed and take 15–75 min. to complete the meal. Second instar nymphal stage is 13–15 days. Adult ticks feed when about a week old and then mate. Oviposition begins 4–5 days after mating. 4–5 batches of eggs, each numbering 55–184, are laid by a female tick. Total number of eggs laid by a mother tick is 491–460. A batch of eggs is laid continuously for 8–20 days. Feeding and mating appear essential before each batch of eggs is laid. Mother ticks normally live for about 145–187 days. Among adults about 56.6% are male and 43.4% female. During cold months under unheated conditions reproduction stops.

**95. Observations on the Bionomics of *Hunterellus hookeri*, the Parasite of ticks in India, (With two plates).**

B. N. SONI and S. C. SRIVASTAVA, Izatnagar.

The ravages caused by ticks affecting domesticated animals in India are well known. The losses sustained by the stockowner, the dairyman and the hide merchant are enormous. Studies on the subject of biological control of ticks in India has been in progress for some time past.

*Hunterellus hookeri*, the parasite of ticks, is so far known to occur in the States of Madras, Bombay and Uttar Pradesh. The host tick is attacked only in its nymphal stage. Under natural conditions, the parasite diminished in number during the hot season (April to July) and is at its maximum during the winter months (September to December). It is now possible to keep a continuous strain of the parasite in the laboratory at a temperature of 18°–24°C and relative humidity 70–75 per cent. The parasite could thus be introduced in large numbers in any tick infested locality through parasitised nymphs bred in the laboratory.

## SECTION OF AGRICULTURAL SCIENCES

*President* :—DR. E. S. NARAYANAN, M.A., Ph.D. (Lond.), D.I.C.,  
F.R.E.S., F.E.S.I., F.A.Sc.

### *Abstracts*

#### AGRONOMY

##### 1. Studies on the humification of the leguminous and non-leguminous weeds in the 'Mumat' soil of Agra district.—Part I

ABANI K. BHATTACHARYA and B. R. NAGAR, Agra.

Changes in porosity, sticky point, moisture content and exchangeable calcium by humifying the *legumes* :—1. Kanji (*Pongamia glabra*) 2. Chakwad and *non-legumes* :—1. Arousa (*Justicia adhotoda*). 2. Chhota Dahatura. 3. Anjana grass (*Cenchrus ciliaris*).

Two legumes :—Kanji and Chakwad and three non-legumes :—Arousa, Chhotta Dahatura and Anjana grass were humified in the Dumat soil of Agra district and the changes in the porosity, sticky point, moisture and exchangeable calcium during humification, under laboratory conditions, were studied.

Sticky point and porosity gave higher values for the humified soil samples. It is interesting to note that porosity and sticky-point seem to be related in that they tend to decrease or increase together in majority of cases. Moisture content is much increased in consequence of humification of the afore-mentioned weeds. Exchangeable calcium increases appreciably on humification in most cases. Chakwad (leguminous), however, gave the highest increase of exchangeable calcium.

##### 2. Studies on the humification of the leguminous and non-leguminous weeds in the Dumat soils of Agra district.—Part II

ABANI K. BHATTACHARYA and B. R. NAGAR, Agra.

Changes in the Nitrogen and Carbon contents by humifying the *legumes* :—1. Kanji (*Pongamia glabra*). 2. Chakwad and *non-legumes* :—1. Arousa (*Justicia adhotoda*) 2. Chhotta Dahatura 3. Anjana grass (*Cenchrus ciliaris*).

Two legumes :—Kanji and Chakwad and three non-legumes :—Arousa, Chhotta Dahatura and Anjana grass were humified in the Dumat soils of Agra district and the changes in Carbon and Nitrogen during humification, under laboratory conditions, were studied.

The interesting fact that arises out of the above investigations is that the Nitrogen was increased both by legumes and non-legumes. The mineralisation of organic nitrogen was found to correspond to the C/N ratio (below 13.09) as had been observed by the previous workers. Excess of mineralisation was observed in all cases and this was in agreement with the view of previous workers on the percentage of Nitrogen in the weeds higher than 1.7%. Maximum mineralisation took place when C/N ratio was between 5.6 during the period of 8 to 16 weeks of humification.

### 3. Studies on the humification of the leguminous and non-leguminous weeds in the Dumat soils of Agra District.—Part III

ABANI K. BHATTACHARYYA, B. R. NAGAR and  
AMAL K. BHATTACHARYA, Agra.

Changes in pH and conductivity by humifying the legumes :—1. Kanji (*Pongamia glabra*), 2. Chakwad and non-legumes :—1. Arousa (*Justicia adhotoda*), 2. Chhotta Dahatura, 3. Anjana grass (*Cenchrus ciliaris*).

The variations in pH and conductivity during the humification of the two legumes—Kanji and Chakwad and three non-legumes—Arousa, Chhotta Dahatura and Anjana in the 'Dumat' soil of Agra district have been studied under laboratory conditions. It was observed that during the whole process of humification (18 weeks) a rise in the pH and fall in conductivity went together at different stages. The soil tended to become alkaline when Kanji, Arousa and Anjana grass were humified while it drifted to slight acidity in the last stage of the humification of Chakwad and Chhotta Dahatura.

It has been suggested that the variation in pH during humification were mainly due to the following factors :—

(1) Liberation of organic acids, (2) Exchange of bases Ca, K and Na, (3) Reactivity of organic acids on the clay minerals.

The amphoteric nature of the clay humus complex has been suggested to be the reason for the small variations in pH values observed during the humification of the above mentioned weeds.

### 4. Irrigation and Water Requirements of Principal Crops in Uttar Pradesh.

A. P. BHATTACHARYA, Roorkee.

The importance of irrigation and correct requirements of water for crops have been discussed. The experiments set forth here were taken up with a view to the determination of the most economical use of water for getting the maximum and optimum yield of the principal crops of Uttar Pradesh. The crops experimented upon were sugarcane, wheat and rice. The experimental stations were selected at various places which were typical of the different climatic conditions of Uttar Pradesh. The farming practice was kept uniform for a particular experiment and adhered to that adopted locally. Variations were made only in the combination of the depth of irrigation and the interval between waterings. The designing was done on randomized block system.

For sugarcane, conclusive results were obtained for Bulandshahr, where four inches depth of irrigation at an interval of three weeks gave the maximum yield and the same depth at four weeks' interval produced the optimum yield. For wheat, one watering treatment was found to suffice for the wetter regions of eastern Uttar Pradesh such as Bara Banki but for the drier regions of western Uttar Pradesh, two waterings were needed. Some indications of the utility of an early irrigation treatment and also of the interval (of four weeks) were obtained. In the case of rice, nine inches depth of irrigation seemed to produce the maximum yield.

### 5. Effect of N, P, K, on the Yield and Quality of *Corchorus Olitorius*.

B. K. DAS, D. B. DUA and B. C. KUNDU, Barrackpore.

To study the effect of different levels of N, P, K, singly and in their combinations on the yield and quality of *Corchorus olitorius*, (Var. JRO-632) a manual

trial was conducted in a replicated randomized block lay-out during 1953-54, 1954-55 and 1955-56. The trial was carried out on the sandy loam soils (of average fertility) in the Jute Agricultural Research Institute Farm at Nilganj. Three levels of N (0 lb. ( $N_0$ ), 20 lb. ( $N_1$ ) and 40 lb. ( $N_2$ ) per acre), two levels each of K (0 lb. ( $K_0$ ) and 25 lb.  $K_2O$  ( $K_1$ ) per acre and P (0 lb. ( $P_0$ ) and 40 lb. ( $P_1$ )  $P_2O_5$  per acre) and their combinations were tried, the sources being ammonium sulphate as N, muriate of potash as  $K_2O$  and single superphosphate as  $P_2O_5$ .

The data for all the three years were subjected to serial analysis. It has been found that the effect of N was significant.  $N_1$  and  $N_2$  either alone or in combination with P or K or PK increased the yield of fibre significantly. The responses of P or K or both were not positive. The highest mean yield of 24.93 mds. per acre was recorded from the treatment  $N_2P_1K_1$ . This was very closely followed by  $N_2P_1$ ,  $N_2K_1$ ,  $N_1P_1$ ,  $N_1$ ,  $N_1K_1$ ,  $N_1P_1K_1$  and  $N_2$ , all of which came in the same critical group with  $N_2P_1K_1$ . It is, therefore, seen that there is no marked difference in yield of fibre between the treatments  $N_1$  and  $N_2$ . With  $N_1$  the mean average yield obtained was 24.15 mds. per acre yielding 23.4% higher than the control. For *olitorius* jute  $N_1$  (20 lbs. N per acre) therefore, seem to be most economical for Nilganj light soil areas so far the yield of fibre is concerned.

$P_1$ ,  $P_1K_1$  and  $P_1N_1$  have been found to improve the quality of the fibre in all the three years. Nitrogen in two years tended to deteriorate the quality of fibre. Variations in the quality ratio of the fibre from any particular treatment from year to year have, however, been observed.

#### 6. Response of varieties of *Corchorus Olitorius* to different levels of nitrogenous fertilizer (Ammonium Sulphate).

° B. K. DAS, D. B. DUA and B. C. KUNDU, Barrackpore.

To study the responses of 4 varieties of *olitorius* jute at 4 levels of manuring with a view to finding out the most suitable variety with its optimum dose of manuring under Nilganj conditions (light sandy loam soils) a trial in a strip design layout was started in 1955-56. The varieties tested were JRO-632 ( $V_1$ ), JRO-620 ( $V_2$ ), C.G. ( $V_3$ ) and a local type ( $V_4$ ) and the manurial levels were 0lb. ( $M_0$ ), 20 lbs. N ( $M_1$ ), 40 lbs. N ( $M_2$ ) and 60 lbs. N. ( $M_3$ ) from ammonium sulphate. From the results it is found that the effect due to varieties and manures were both significant at 1% level of probability, but that due to interaction (variety  $\times$  manure) is insignificant. Among manurial treatments  $M_1$  (i.e. 20 lbs. N) had given the best result being significantly superior and yielding on an average an extra yield of 3.79 mds. of fibre per acre over the control 0lb.N. Any further addition of N did not increase the yield of fibre. Among the varieties tested JRO-632 has proved to be the best giving on an average an extra yield of 3.58 mds. per acre over the standard variety C.G. This was closely followed by the Local (which appears to be a mixture of improved type of J.A.R.I.) and is also superior to C.G. The third one in order of magnitude is JRO-620 which had yielded slightly more than C.G. Statistically there was no difference between JRO-620 and C.G. The behaviour of different varieties to different manurial levels were similar, and no one variety gave any differential response.  $V_1M_2$  combination has given the maximum yield of 22.01 mds. as against 13.94 mds. from  $V_4M_1$  (the standard variety C.G. without fertiliser).

The variety JRO-620 had given the best quality of fibre. Addition of nitrogen always tended to deteriorate the fibre quality.

## 7. Preliminary studies on the effect of plant spacing and manuring on Ramie.

A. N. DATTA and P. SANYAL, Barrackpore.

Ramie (*Boehmeria nivea*), a stingless nettle plant belonging to the family Urticaceae has, in recent years, gained much importance as a textile fibre which ranks first among all vegetable fibres in respect to strength and fineness and works on different cultural aspects on ramie are being reported by various workers from different countries.

A preliminary spacing cum manurial trial was conducted at the Nilganj farm, Barrackpore, in split plot design in 1955-56 with three spacing treatment (1', 2' and 3' ft. spacing between plants in row of 3' ft. spacing between rows) and four doses of nitrogen (no nitrogen, 20 lbs., 40 lbs. and 80 lbs. of nitrogen per acre) in the form of ammonium sulphate applied in three instalments. Intercultural operation consisted of weeding and mulching and care was taken to maintain proper spacing of plants. The crop was harvested at 50% flowering stage and three cuttings were taken during the year.

Records on height, base diameter, green weight and stripped weight of plants for each cutting were taken at harvest. Extraction of fibre, however, could not be done for want of decorticating machine.

Highest green weight (350.55 mds. per acre) and stripped weight (171.29 mds. per acre) per year (total of 3 cuttings) have been obtained in the treatment 80 lbs. of nitrogen per acre of the spacing 3' ft. between rows and 2' ft. between plants within row. For a particular spacing both in and between the rows, green weight and stripped weight have been increased with the increase of doses of nitrogen.

The treatment 80 lbs. of nitrogen per acre of the spacing 3' x 2' ft. (3' ft. between rows and 2' ft. in the row) has given the maximum plant height (36.1 inches) and base diameter (1.13 cm). Like green weight and stripped weight, higher doses of nitrogen also increase the plant height and base diameter for a particular spacing both in and between the rows.

8. Effect of natural activators (*Dhaincha-Sesbania Aculeata* and sunnhemp—*Crotalaria juncea*) in reducing the retting period of Jute.

G. HALDER and A. K. KUNDU, Barrackpore.

It has already been found that ammonium sulphate either singly and in combination with bonedust considerably reduces the retting period.

It was therefore thought that green manuring plants like *Dhaincha*—(*Sesbania aculeata*) and Sunnhemp—(*Crotalaria juncea*) stems, which take much shorter time to ret, may reduce the retting period, with this purpose an experiment was started where these plants were put in the bundles of jute (for every 10 jute stems, one *dhaincha* or sunnhemp stem was added) and were allowed to ret.

It has been found that *Dhaincha* and Sunnhemp either alone or in combination with Bonedust reduces the retting period more than even ammonium sulphate and bonedust in combination. The phenomenon is more marked when the temperature was less. It may therefore be suggested that if these two green manuring crops are grown in the border wherever possible and put in small quantities in the retting bundles with jute, a larger quantity of jute may be retted in a given volume of water.

**9. Effect of some Kharif Crops on Soil Fertility.**

K. K. JHA, P. SINHA and M. A. SIDDIQUI, Sabour.

5 years' yield data of wheat grown in a loamy soil at Sabour after maize (*Zea mays*), Jowar (*Andropogon Sorghum*), Soybean (*Glycine Soya*), Kalai (*Phaseolus mungo*) and 3 years yield data of wheat grown after mung (*Phaseolus mung* Var. *radiatus*) for the grain purposes in the same plot year after year without manuring either in Kharif or rabi, have been studied in relation to nitrogen, organic matter, exchangeable bases, pH, aggregation, CO<sub>2</sub> evolution in soils and N and P contents in plants. The investigations confirmed the previous findings of Mandal and Mukherjee that Kalai and mung are the best preceeding crops for wheat and that Jowar has depressing effects on the yield of wheat crop.

The effects of Kalai and mung if grown in the same plot year after year however show diminishing trend on account of decline in the status of nitrogen, organic matter and exchangeable bases in the soil and also partly due to rise in pH values. It is therefore not possible to maintain kalai and mung grown soil in the increased state of fertility for more than two years, unless the soil is supplemented with manures and fertilizers. The beneficial effects of kalai and mung were found to be not only due to nitrogen donation by these crops but also due to supply of crop residues of lower C/N ratio which enable rapid N mineralisation and increase in available nitrogen contents of soil. Beneficial effects of kalai and mung were partly also due to the fact that inspite of more abundance of total and available nitrogen, wheat grown in these plots utilised nitrogen and phosphate more economically than in the case of other crops.

**10. Growth and Development of Jute with special reference to fibre percentage in the stem.**

B. K. KAR and B. K. DESARKAR, Barrackpore.

The two commercially important species of Jute (*Corchorus capsularis* & *C. olitorius*) were studied during the complete life-cycle of the plant with reference to the individual production of different growth components as Green wt. Dry wt. Bark wt. Fibre wt. and Wood wt. and the relationship of fibre production with reference to the production of other components. Some of the results obtained are given as follows:—

(1) Fibre was formed in the stem at a very early stage. At 50 days growth an appreciable amount of total fibre 0.74 gms. in dry weight was found for a stem length of 30" in D154 (*capsularis*) and 0.66 gms. in C.G. (*olitorius*) for the same length.

(2) The fibre formation as a result of initial meristematic activity in the apical region of the stem was very meagre in both the species as compared to the fibre formed due to the activity of the successive layers of cambium in the same region.

(3) The specific differences in the fibre production was manifested with the appearance of the activity of the cambial layers in the growing stem begining from apical region downwards.

(4) The percentage distribution of fibre along the stem showed a greater percentage of total fibre concentrated in the bottom regions of D154 than in the corresponding regions of C.G.

(5) The production of the individual growth components at different stages showed higher values in C.G. But the calculated percentage of fibre production in terms of the total green or dry weight of the stem, always showed a higher percentage of fibre values in D154 than in C.G.

(6) The results are important from the point of view of plant selection on "fibre percentage" in addition to Basal diameter and height.

**11. Investigations on Salt Tolerance in Jute (*Corchorus*).**

B. K. KAR and B. K. DESARKAR, Barrackpore.

In order to find out the possibility of cultivating Jute in certain saline tracts of West Bengal, certain investigations were continued on the salt resistance of jute, both *capsularis* and *Oltorius* varieties. The preliminary results are reported here as follows :—

(1) Germination of seeds in conc. of 0.5%, 1.0% and 1.5% of NaCl showed toleration upto 1.0% conc. but germination was delayed. From the germination rate *Capsularis* varieties were found more tolerant than *Oltorius* varieties.

(2) Pre-sowing salt treatment with 0.5% soln. of NaCl for 2-3 hours brought a slight increase in salt resistance, as shown by the performance of the seedlings raised from them.

(3) The rate of transpiration in *Oltorius* varieties was more suppressed than the rate of transpiration in *Capsularis* varieties when grown under same salt conc. showing thereby more resistance of *Capsularis* varieties.

(4) Field trial experiments in Kakdwip area of Sunderbans, West Bengal in soil salinity of (1.2-7%) with 5 varieties of *Oltorius* and 5 varieties of *Capsularis*, showed better performance by *Capsularis* varieties. The plants were also retted in the saline water of (2 to 2.5% of salinity) 2 to 25% of the locality giving fibre of average quality.

(5) Wild species of jute—*C. Siliquosus*, *C. tridens* and *C. trilocularis* were found more resistant than cultivated sp.

**12. Retting of jute—Part V Influence of Fertilisers on the retting period**

B. C. KUNDU, M. K. MUKHERJEE and G. HALDER, Barrackpore.

It has been shown that jute plants if grown under nitrogenous fertilisers contain higher percentage of nitrogen. To test how far the fertilisers added to the soil affect the retting period, an experiment was laid out. In the controlled retting tanks, the experiment was continued with plants obtained from manurial experiments, where phosphate as superphosphates, nitrogen as ammonium sulphate and composts were added from very small to very high doses.

It has been found that plants obtained from only superphosphate and compost treated plots took slightly longer time than control and plants from only ammonium sulphate treated plots took slightly shorter time than control whilst plants from plots where ammonium sulphate and composts were added in combination or ammonium sulphate and superphosphate were added in combination, the retting period was considerably lower than the period taken by plants obtained from control plots or even ammonium sulphate treated plots to ret.

It may be further mentioned that this experiment shows that phosphate manuring though alone may not be beneficial to jute but along with nitrogen it has an important role in reducing the retting period.

**13. Effect of Extensive use of Fertilizers, with or without organic manures and Orchard Soil.**

P. C. MALLIK and JANARDHAN JHA, Sabour.

Effect of extensive use of fertilizers (N, P and K) on mango orchard soil has been discussed and recommendations have been made to obliterate the harmful effect of the continuous use of inorganic salts and to minimise wastage.

To find out nutritional requirements and preference if any, to any particular elements of the mango, N (Am sulph) P (Superphos) and K (Potash sulph) had



been used singly and in combinations in equal doses (128.8 lb. per acre) since 1940. In 1951 organic manure and Mn application had been superimposed without altering the general layout of the experiment.

The whole orchard has come to an equilibrium condition with regards to the nitrogen status. The plants are using all the nitrogen that is being added, the soil reserve remaining unaltered in individual plots. In spite of the organic matter added, C/N ratio remained constant. The N plots showed signs of Ca depletion, the pH coming down from 7.4 to even 5.6.

The total phosphates and Potassium increased upto a certain limit and available phosphorus remaining nearly constant except in plots receiving nitrogen where it decreased showing that Nitrogen helps Phosphate up take by the plants. Humus in the soil also helped in releasing Phosphate. The relative highest piling up of P in soils receiving this element and very little depression of it in plots not receiving it are suggestive of a relatively low phosphate requirement of mango.

Potash level has been lowered in plots recovering N and NP but not receiving K, indicating an increased utilization of K with increase in N. Potash level is higher in subsurface stratum. The plants are not showing any Potash deficiency symptoms and hence it is concluded that the extra potassium has leached down. Higher potash levels in plots c, p and pk than those in n, nk, and nlk plots show that nitrogen increases Potash uptake by the plants.

Recommends split application of manures and fertilizers, deep placement of Phosphates, liming and more humus in the orchard soil.

#### 14. After-effects of treatment of seeds of an early variety rice with some growth regulators.

G. MISRA and G. SAHU, Cuttack.

Seeds of an early variety of rice (N.136) were soaked for 72 hours in three concentrations 500, 250 and 100ppm (parts per million) of each of the three growth regulators i.e.  $\beta$ -indolyl acetic acid (IAA),  $\alpha$ -naphthyl acetic acid (NAA) and 2, 3, 5-triiodobenzoic acid (TIBA) and were sown in earthenware pots. Slight earliness in flowering is observed in plants treated with TIBA solutions, and delay in the plants treated with NAA. Plants treated with IAA solution did not show any marked difference in flowering from the controls. Maximum delaying effect is obtained in case of plants treated with 500ppm NAA. Plants treated with IAA and TIBA solutions show a better vegetative growth, while the plants treated with NAA show a tendency of late flowering and less vegetative growth with a gradual increase in the concentration of the auxin. The grain yield is higher in plants treated with all concentrations of IAA, 500 ppm NAA and 500 and 250 ppm TIBA in comparison with the controls, highest being observed in the plants treated with 500ppm IAA solution. Higher grain yield is generally due to greater number of panicles per plant, longer panicles, greater number of grains and spikelets per panicle, higher percentage of grains set per panicle and increase in grain plumpness. In NAA treated plants the percentage seed set as well as grain plumpness, whereas in TIBA treated plants the grain plumpness alone are less than those of the controls.

#### 15. Study of Income and Expenditure pattern of the Jute growing Farm.

S. N. SEN and B. C. KUNDU, Barrackpore, W. Bengal.

From a pilot enquiry conducted in the jute growing tracts in the northern part of District 24 Parganas, West Bengal, during 1953-55, the various sources



of agricultural factors affecting the income and expenditure pattern of the economy of the jute growing farm and the operational cost of cultivation of jute and paddy have been analysed.

A few of the salient features observed during the study are noted below :—

- (a) The average size of the farm is 5.15 acres and the average size of the family is only 10.
- (b) Of the total land, only 34% and 43% are under jute and paddy respectively. In the area cropped with jute, paddy is rotated as the 2nd crop in 21% pulses in 47%, vegetables in 10% of the total jute land. In the area where paddy is the 1st crop, pulses are rotated in 13%, vegetable in 1% and there was no rotation in 86% of paddy land.
- (c) The average annual value of farm products is estimated to be Rs. 2235/-. Nearly 98% of jute is sold for earning cash money. Out of the total output of paddy only 19% is sold and this happens at the period of scarcity.
- (d) The area of jute cannot be increased but by adopting improved practices, the yield rate can be increased considerably.
- (e) The average annual farm expenditure for hired labour is Rs. 608/- which is 62% of total farm expenditure. The percentage distribution of human labour from family and hired sources is 52 and 48 in case of jute, and 68 and 32 in case of paddy. It may be possible to reduce considerably the 'paid' operational cost by replacing hired labour by family labour and using various agricultural implements.
- (f) The average operational costs for the cultivation of jute and paddy are Rs. 218/- and Rs. 119/- respectively, with wide ranges of variation. The percentage distribution of the total cost for human labour, cattle labour, manure and seed is respectively 79, 10, 8 and 3 in the cultivation of jute and 68, 19, 7 and 6 in case of paddy.
- (g) In the study of the consumption pattern of the family budget of the jute cultivator, the 'per capita' income is estimated to be Rs. 209/-. The percentage of total expenditure on food, clothings, fuel-light, education and miscellaneous items were respectively 73, 5, 6, 7 and 9.
- (h) The margin of profit of a farm in this area is too low. It is hardly possible to incur extra expenditure on the purchase of livestock or implements unless the farmer gets sufficient loan.

#### 16. Measurement of leaf area of Tobacco.

K. G. TEJWANI, C. K. RAMAKRISHNA KURUP and  
K. V. VENKATARAMAN, Rajahmundry.

Tobacco differs from most other cultivated crops in that the commercially important part of the plant is the leaf. The bigger the leaf, the better it is prized in the market. For evaluating the effect of various cultural, manurial and other practices on the yield and quality of tobacco it is necessary to know the size of the leaf. This study was undertaken to obtain an empirical relationship between the actual leaf area (A) and the maximum length (L) and maximum breadth of the green cigar tobacco leaf (*N. tabacum* var. *Vellativashai*). Other additional objects of this study were to investigate whether (a) the total leaf area of the whole mature cigar tobacco plant topped to 14 leaves could be computed by recording the area of some selected leaves only and (b) the formulae developed

for cigar tobacco leaf were applicable to flue-cured tobacco. The following regression equations and relationships were established :—

- I. Area (A) of green cigar tobacco leaf  $= 0.66 X + 6.2$  when the area is between 0.0–20.0 sq. inches;
  - II. Area (A) of green cigar tobacco leaf  $= 0.60 X + 4.2$  when the area exceeds 20.0 sq. inches;
- where X = product of the maximum length and maximum breadth in inches of the leaf.
- III. The estimate of total leaf area of mature cigar tobacco plant topped to 14 leaves = Sum of the area of leaf positions 6, 7, 8 and 9 starting from the bottom }  $X \cdot 3.125$
  - IV. The leaf area formula II above for cigar tobacco leaf is applicable to the mature green leaf of flue-cured Virginia tobacco (*N. tabacum* var. *Harrison Special*).

#### 17. Growth and quality of Cigar Tobacco Leaf as influenced by its position on the stalk.

K. G. TEJWANI, C. K. RAMAKRISHNA KURUP and  
K. V. VENKATARAMAN, Rajahmundry.

Growth and quality of cigar tobacco leaf (*N. tabacum* var. *Vellaivazhai*) as influenced by its position on the stalk has been investigated. It was observed that when the cigar tobacco plant was topped leaving 14 leaves on the stalk, the bottom most four leaves, which were more or less fully developed at the time of topping developed very little afterwards. On the other hand, after topping, new growth was confined mostly to the upper half of the plant, the top most three leaves making more than 50% growth. According to the local practices of grading, leaves at positions 5 to 14 (starting from the bottom) gave higher percentage (weight) of good grade leaf than that given by leaves at positions 1 to 4. Leaves at positions 5 to 12 had the best burn, leaves at positions 13 and 14 had medium burn while leaves at positions 1 to 4 had the poorest burn. Considering the general quality of the leaf, it was observed that leaves at positions 5 to 14 gave better quality leaf than that obtained from leaves at positions 1 to 4. The poorer quality of the leaves at positions 1 to 4 was explained to be due to their incomplete curing and fermentation and the depletion of their contents by translocation to the upper leaves.

### AGRICULTURAL CHEMISTRY

#### 18. A Study on the quality of waters of important rivers in India.

B. C. DEB and S. P. CHADHA, Poona.

Very little data is available on the quality of water of Indian rivers. A systematic analysis of water from various rivers from different sites has been taken up. The conductivity, pH, Na, K, Ca, Mg, CO<sub>3</sub>, HCO<sub>3</sub>, and Cl have been estimated in the samples collected from August, 1955 to June, 1956. It has been found that conductivity is generally below 400 for all the water samples during monsoon period; conductivity gradually increases during dry period but the increase is not much in case of samples from North Indian rivers; whereas it increases considerably for South Indian rivers like Krishna, Godavari and Tapi. The predominant cation is calcium followed by either sodium or magnesium and then potassium. The

predominant anion is the bicarbonate which is generally more than 80% of the total anions. Hardness number of water samples from all the rivers during monsoon period is less than 150, hardness number is above 150 for some samples from South Indian rivers during dry seasons. Sodium percentage is below 50 for all the samples during monsoon period. It is above 50 but below 75 for some of the samples from South Indian rivers during dry seasons. It may, therefore, be said that waters of Indian rivers are good during monsoon period, both for irrigation and most of the industrial purposes, but during dry seasons the waters of South Indian rivers are not always class I with regard to irrigation or industrial purposes.

**19. The effect of cuttings and spacings on the yield and Chemical composition of *Panicum Antidotale*, retz.**

R. CHANDA, S. N. SENGUPTA, A. K. CHAKRAVARTY and  
A. P. CHAUDHURI, Haringhata.

*Panicum antidotale*, because of its adaptability, persistency and good seeding capacity, was grown in observation rows and in different rows at a spacing of 9", 18", 24" and 30" inches to study the variations, if any, in the yield and chemical composition of fodder. Cuttings were taken at intervals for the determination of chemical composition.

The results of findings are summarised below :—

The average percentage of dry matter of the grass grown in the observation rows was  $22.05 \pm 4.1$ , and crude protein  $13.88 \pm 3.55$ , ether extract  $1.75 \pm 0.29$ , crude fibre  $27.62 \pm 2.9$ , nitrogen-free extract  $48.76 \pm 2.75$ , ash  $8.90 \pm 1.45$ , calcium  $0.39 \pm 0.09$ , phosphorus  $0.34 \pm 0.08$ , on dry matter basis.

The grass when grown at a spacing of 9" inches, yielded comparatively greater quantity of fodder and crude protein per unit area than that grown at 18", or 24" or 30" inches spacings. The variations in the other organic and inorganic constituents of the grass due to different spacings were not statistically significant.

The yield of the grass varied between cuttings, the maximum being recorded in the second cut. On the other hand, the crude protein of the grass was largest (20.4%) in the first cut and varied between 11.7 and 13.8% in the subsequent cuts. The yield of the fodder was so large from the second cut that the highest yield of crude protein was also recorded from the same cut in spite of the fact that the crude protein content in the second cut of the grass was only 12.8%.

Incidence of weeds was found to be comparatively less in the closely spaced plots.

**20. Manganese nutrition of Plants II. Calcium Manganese interrelationship.**

S. C. MANDAL, Kanke.

The interrelationship of calcium and manganese ions in the feeding medium of plants has been studied in a sand culture experiment with *Kalal (Phaseolus mungo)* as the experimental crop. The crop was grown with various combinations of different concentrations of calcium and manganese. The calcium concentration varied from 12 p.p.m. to 600 p.p.m. and manganese from 0.1 to 12.5 p.p.m. The growth studies and analytical data indicate that manganese concentration in plants is a function of its concentration in the feeding medium. Increasing doses of calcium may lower the uptake of manganese by plants, to a certain extent, but the total amount of manganese in the plant depends more on the concentration of manganese in the nutrient medium. It seems that no Ca/Mn ratio in the nutrient medium would serve as a proper guide to the extent to which the uptake of

calcium and manganese would take place unless their concentrations in the feeding medium are known. Similarly the Ca/Mn ratio in the plant may not always correlate with manganese toxicity though narrow ratios would ordinarily suggest manganese toxicity.

#### 21. Some further studies on the re-use of curing salt: Part I.

S. C. NANDY, S. N. SEN and B. M. DAS, Madras.

It is a common practice in India and some other countries e.g. United States, South Africa etc. to apply used salt to cure a new pack of hides and skins. Objections were raised by a number of workers to the suitability of the used salt for curing purpose and it was shown to contain much higher bacterial count than that of the unused salt. Hides and skins are often allowed to be staled before curing or put to process due to unavoidable reasons whereby these are attacked by putrefactive micro-organisms to different extent. To find out whether this staling period before curing affects the bacterial flora of the salt collected from this cured stock, salt samples were collected from hide pieces cured after different periods of staling. It was found that the bacterial count increased rapidly in comparison to the unused control salt with the increase of the staling period which indicated the possibility of enhanced bacterial action if such salts were re-used. It was also found that the total nitrogen content of the salt samples increased with the period of staling which probably served as nutrition for the growth of the bacteria in brine solution.

#### 22. Application of hand Refractometer in Khandsari Sugar industry.

S. C. SEN and J. C. BHARGAVA, Kanpur.

The successful use of Hand Refractometer was first suggested in India by Khanna and Sen in the harvest control in sugar factories in succession of refining. The equations deduced by Khanna and Sen or Sen for sugar factories could not be applicable to khandsari Sugar Mills. In this paper equations have been deduced statistically to calculate the Recovery % cane in Khandsari Sugar Mills from the brix values of standing canes.

A very strong positive correlation between brix and Pol % juice of crusher juice has been established;  $y = 1.136x - 5.76$ , where  $x$  = Brix of crushed juice and  $y$  = Pol % juice.

A very strong positive correlation between Pol % Juice and Khandsari Sugar Recovery % cane by sulphitation process has also been established;  $y = 0.5x - 0.43$ ; where  $x$  = Pol % crusher juice and  $y$  = Khandsari Sugar Recovery % Cane.

The difference between the observed values and the values obtained from the calculated values of a few cases examined was found non-significant.

#### 23. Effects of Phosphate on Bacterial Inoculation in Green Manuring.

P. SINHA, K. K. JHA, M. A. SIDDIQUI and R. SINGH.

Of various factors essential for the success of green manuring, presence of effective rhizobia in the root nodules of leguminous green manure plants, to draw maximum N from air, is of great importance. With a view to improve the stand of green manure plant and thus increase its soil building properties, replicated trials on bacterial inoculation with and without phosphate are in progress since the year 1955-56 at Agricultural Research Institute, Sabour (Bihar). Wheat is

being grown as a succeeding crop. Besides yields of green manure and wheat grain and straw, regular observations on time and nature of nodulation in sunhemp plant in different treatments are also made. Soil analysis of composite samples collected at sowing of wheat for total N and organic carbon and N & P determinations in wheat grain and straw in composite samples are also done.

First year's data are now available. Green manuring without phosphate did not increase the N content of the soil, which suggests that nitrogen donation by a green manure crop should not always be taken for granted. Phosphate @ 40 lbs./acre along with the green manuring increased N content of the soil by 3.5 to 3.7 mgms. per 100 gms. of soil which shows clearly that phosphate manuring of a green manure crop helps considerably in fixation of extra nitrogen from the air.

Seed inoculation—phosphate treatment which although gave 25 mds. extra yield of green manure and the highest yield of grain of the succeeding wheat crop, did not add any extra nitrogen to the soil compared to no inoculation—phosphate treatment. The beneficial effects of seed inoculation-phosphate treatment were thus not due to any extra N fixation. This treatment, on the other hand, exhibited early nodulation by 10 days. From literature cited phosphate is known stimulate the motility of rhizobia. This state of motility of the organisms seems to be responsible for above mentioned early nodulation.

During the process of seed inoculation, the organisms are made to adhere on the seed coat and in culture, the organisms are already in motile state due to the presence of some soluble phosphate. It has, therefore, been suggested that beneficial effects of seed inoculation-phosphate treatment may be due to an early nodulation brought about by highly motile cells on account of their nearest approach to plant root.

## AGRICULTURAL ENGINEERING

### 24. Abstract of Mechanics of indigenous plough.

A. C. PANDYA, Kharagpur.

An indigenous or *deshi* plough is acted upon by three major forces : (1) gravity, (2) pull, and (3) soil resistance. Soil resistance is classified as useful and parasitic. The action of the three forces given above can be analysed by standard methods. The forces will have moments as they do not act at a point though they are coplanar. While designing the plough, moments of forces should be balanced. The method of depth control of the indigenous plough is analysed.

## AGRICULTURAL ENTOMOLOGY

### 25. Malformations in some plants.

D. BAP REDDY, Rajendranagar, Hyd. State.

Malformation of Mango fruit, twigs and branches of sapota, (*Acharas sapota*), and sunhemp (*Crotalaria juncea*) were observed at Ravalkole, Sangareddy and Raichur. Small flattened eruption like structures were noticed on Mango fruit on the tree. The appearance of the fruit looked scabby. There was no difference either in the colour or taste of the affected fruit. These gall like structure are suspected to be due to insect feeding. No organism could be isolated.

Flattening of small twig was noticed in sapota. The flattening extended to the apex of twig also. The leaves and flowers on the flattened twigs are small

and distorted, especially flowers. There is no fruit bearing on the flattened twig. Similar flattening of small branches was noticed on sannhemp. Here the flattening was of less extent. In both the cases there was no death of the leaves or the twig or branch itself. No organism could be isolated from these flattened twigs. The cause is suspected to be of physiological disorder.

## 26. Scab on Grapes.

D. BAP REDDY, Himayetsagar, Hyd.-Dn.

The most popular grape in the State is the Anabe Shahi, which is a very good table variety. Berries are bold and bunches are compact. This variety suffers severely from Powdery mildew, *Uncinula necator*, downy mildew *Plasmopara viticola*, and Anthracnose, *Gleosporium ampelophagum*. In recent years growers are experiencing the seriousness of a new disease which is called scab. The symptoms of the scab are rather characteristic and can be easily distinguished from other diseases mentioned above.

Symptoms appear on young berries and persist and continue to spread and appear till maturity. On the exterior of the berry first small brownish specks appear and later they spread in size some time the whole berry is covered. In severe cases malformation of berry takes place due to uneven growth. The scab like coating on the berry can easily be removed without injuring the berry. Under the scabbed portion, the colour of the berry is natural. At the maturity of the fruit the scabbed portion looks cracked and can be felt as a raised surface if touched. There is no serious apparent loss to the grapes due to scab except that the market value is reduced immensely and in cases of severity of the disease some malformation of berries takes place. Berries look natural when the scab is removed from the surface and can be consumed, willingly.

Many attempts in the laboratory to isolate the organism responsible for scab were not successful. Scab has become serious and some times almost all bunches are attacked by the Scab. Dipping of bunches in lime sulphur have been reported to be helpful. Some hormone type of chemicals have been tried but no encouraging results were obtained. No satisfactory control measure has been yet evolved.

The Scab may be caused due to some physiological or mechanical factors rather than from any organism. Mechanical injury to the berries, perhaps due to insect feeding, may result in the formation of Scab.

## 27. Notes on breeding technique and life history of *Apanteles tachardiae*, Cam.—an endoparasite of lac predator, *Holcocera pulverea*, Meyr.

N. S. CHOUHAN and S. KRISHNASWAMI, Namkum, Ranchi.

*Apanteles tachardiae* Cam., is one of the important endoparasites of the larvae of *Holcocera pulverea*, Meyr., a major predator enemy of lac. With a view to developing this braconid for the biological control of *Holcocera*, detailed studies were taken up in 1955 by the authors. From an observation of the parasite behaviour, a successful technique of breeding on its natural host as well as an easily available alternative host (larvae of *Corcyra cephalonica* Staint) has been developed. Further attempts on improving the technique for mass breeding of the parasite is under progress. A temperature of about 25°C. and relative humidity of about 75 to 95% seem to be optimum for breeding of this parasite, and parasitism occurs in the first instar stage of the natural and alternative hosts.

Descriptive notes on mating, oviposition behaviour, developmental stages of the parasite and effect of parasitism on the host are given.

Life history studies have indicated that the total life-history period varies between 15 to 40 days during the different months of the year, taking generally a longer time during the cooler months.

Three hyperparasites emerging from the cocoons of this braconid are also listed.

**28. Effect of variations in the time of sowing of *Hibiscus cannabinus* on the incidence of *Agrilus acutus*.**

N. DUTT and S. P. BHATTACHERJEE, Barrackpore, W. Bengal.

*Agrilus acutus* has recently turned out to be an important pest of *Hibiscus cannabinus*. To find out the safer period from incidence of the pest, field trials were carried out with different dates of sowing starting from February and ending in August. No incidence of the pest was observed in crops raised during February or early part of March. Similarly when sowing is delayed beyond June, the crop also escaped damage. Crops sown during the second half of April, record highest damage percent. It has also been found that crop sown during the later part of March gave maximum plant height, base diameter and fibre yield while sowing beyond June effects the yield considerably. Hence sowing of the crop during the later part of March is safer from the point of view of incidence of *Agrilus acutus* and also ensuring higher yield of fibre.

**29. Varietal responses of some rice varieties to attack by the rice stem borer—*Schoenobius incertellus* Wlk.**

M. Q. KHAN and D. V. MURTHY, Hyderabad.

The improved rice varieties HR. 8, 19, 21, 22, 33 and local 'Teksannal' were under experiment to determine the relative susceptibility of the varieties to the stem-borer *Schoenobius incertellus* Wlk. The statistical analysis of the data reveals that the differences in production of stem-bored earheads amongst the varieties under test are significant. The variety HR. 19 is more susceptible to the stem-borer in the second crop season than in the first season. HR. 22 in general is more prone to the *Schoenobius*. It is an aromatic variety slightly awned. Greater number of egg-masses have also been recorded on this variety. Varieties MTU-15 and CH. 47 are more resistant to the stem-borer than other varieties but the yields are lower than the local improved varieties.

**30A. Physiology of digestion of the Adult *Aulacophora foveicollis* Fabricius (the red Pumpkin beetle).**

RATTAN LAL, and SWARAJ GHAI (Miss), New Delhi.

Investigations were undertaken on the Physiology of Digestion of the adult *Aulacophora foveicollis* Fabricius. It has been found that the hydrogen ion concentration of foregut, midgut and hindgut are 6.0, 6.4 and 6.2 respectively. The midgut has been found to secrete amylase, maltase, invertase, lactase, trypsin and erepsin. There is a clear indication of the presence of amylase in the malpighian tubules. It is interesting that although the midgut has been found to have acidic pH the two proteases (trypsin and erepsin) secreted by the midgut have been found to act in alkaline media.



30. Effect of nutrition on the longevity, fecundity and sex ratio of *bracon gelechiae* ashmead using *Corcyra cephalonica* stainton as its host reared on various synthetic diets.

R. N. KATIYAR, New Delhi.

The role of nutrition in the growth of insects is one of the recent developments in Insect Physiology. The importance of these studies need no emphasis as these studies have enabled entomologists to prepare synthetic foods on which they could rear and maintain cultures of insects of their choice for both laboratory studies and for many other aspects of research work. In this paper the nutrition and the growth of the larvae of the rice moth, *Corcyra cephalonica* St. have been studied.

The growth of the larvae of *Corcyra cephalonica* St. on juar plus 10% groundnut mixture is the best to that of juar plus 8% yeast as well as on juar alone. It means that the diet rich in fat and protein promotes its growth in comparison to the diet rich in vitamin and consequently bigger and healthier larvae are produced. But when these larvae from all these different diets are exposed to *Bracon gelechiae* Ashm. it behaves quite differently. The fecundity, sex ratio and female longevity of the parasite of the second generation are more on the larvae fed on juar plus 8% yeast than on other diets. The obvious conclusion is that the *Corcyra* larvae have the capacity to digest and accumulate more fatty diet while parasite larvae cannot possibly assimilate the excessive fat reserved in the host body. In other words the host larvae fed on the diet like yeast mixture rich in vitamin B complex are more relished by the parasite as compared with the larvae fed on the diet like groundnut mixture rich in fat and protein. Finally the effect of juar plus 10% groundnut on the host is just the reverse to the effect of this diet on the parasite. The reverse is true for the diet containing 8% yeast for the host and the parasite relatively.

31. A preliminary account of the life-cycle and the larval anatomy of a Chalcid parasite of coccid.

S. MASHHOOD ALAM, Aligarh.

*Euaphycus variolosum* sp.n. is endoparasitic on *Asterolecanium variolosum* (Ratze) which a pest of oak tree, *Quercus robur* L. Neither the host-coccid nor the parasite has more than one generation a year; and their life cycles are so adjusted so as to enforce stable 'host-parasite' relationship.

The egg is distinctly pedicellate. The pedicel is used for the air supply to the developing larva. The larval anatomy deals with the external and internal structures. The structure of the head capsule and the form of the respiratory and nervous systems suggests a higher evolutionary position to the superfamily Chalcidoidea.

32. Corelationship between respiratory metabolism and fumigation susceptibility of Insects.

E. S. NARAYANAN and M. L. PUROHIT, N. Delhi.

"The susceptibility of an insect to a fumigant varies with the rate of metabolism" (Cotton 1932).

"We may take it as working principle in fumigation that toxicity varies directly with the rate of Metabolism" (Munro '36).



On the basis of the above observations, the present studies were undertaken to explore the limitations of the various ranges of factors that govern insect metabolism and to correlate them with the mortality obtained under identical conditions.

The rate of metabolism is governed by factors like stages of insect, irradiation, temperature, starvation, humidity etc. The various ranges of factors under which the rate of metabolism as well as the fumigation mortality studied are :

<i>Stage of insects</i> ...	...	Egg, larval, pupal and adult.
<i>Irradiation</i> ...	...	
X-ray ...	...	3,00,000r; 1,50,000r; 1,00,000r; 50,000; 10,000r; and 5,000r.
Beta particles ...	...	400 $\mu$ c, 300 $\mu$ c, 200 $\mu$ c, 100 $\mu$ c, 60 $\mu$ c and 40 $\mu$ c of P-32 (Radio-isotope).
Ultra-violet rays ...	...	2,750A and 3,650A at 15" for 10 minutes.
Infra-red rays ...	...	1,500A at 15" for 10 minutes.
<i>Temperature</i> ...	...	15°C, 20°C, 25°C, 30°C and 35°C (pre-during, and post-fumigation period).
<i>Humidity</i> ...	...	20%, 50% and 80%.
<i>Starvation</i> ...	...	96 hrs., 72 hrs., 48 hrs., and 24 hrs. starved insects.
<i>Test insects</i> ...	...	<i>Trogoderma granaria</i> Kverts, <i>Torcyra cephalonica</i> Staint and <i>Tribolium castaneum</i> Host.

"The rate of respiratory exchange of an insect is the best criterion for measuring the metabolic activities and the most suitable method so far known for studying the rate of respiration is by measuring the respired carbon dioxide" (Lindgren, 1936). As such a simpler but more precise apparatus for estimating accurate amount of carbon dioxide evolved by insects (even in less than 24 hours) has been devised and carbon dioxide output of insects at variable ranges of factors enumerated above has been estimated.

A parallel series of experiments on fumigation under the same ranges of factors at a standard uniform dosage of 50 mgm./litre/18 hrs. has been conducted and the fumigation susceptibility (by way of mortality response) so obtained has been compared with the amount of CO<sub>2</sub> evolved by other batch of insects under identical conditions.

The preliminary results reveal that a positive relationship between the rate of metabolism of insects and the susceptibility to fumigation exists only under the specific ranges of factors which are now under detailed studies.

Observations have also been taken regarding the longevity, fecundity, induced sterility and loss in weight of the test insects due to irradiation by X-rays, Beta particles (P-32 radio isotope), Ultra-violet rays and Infra-red rays.

### 33. Notes on the Biology of the Parasites of the leaf miner of citrus plants.

E. S. NARAYANAN, B. R. SUBBA RAO and MRS. R. B. KAUR, New Delhi.

*Phyllocnistis citrella* St. assumes the status of a major pest some times in citrus groves all over India. It is always present in the nurseries. The control of the leaf miner is rather difficult and the results obtained by the spraying of nicotine sulphate is always not satisfactory. Biological method of control is one of the possibilities. So a thorough study of the various parasites that attack the pest was made in the orchards of the Indian Agricultural Research Institute. Three parasites namely *Amatellon* sp. new, *Tetrastichus* sp. and *Elasmus* sp. have been recorded as primary larval parasites of the pest. The life histories of the first two named parasites have been studied in some detail. The parasites make their appearance in July and August after the first monsoon showers. Though

the life histories of *Amatellon* and *Tetrastichus* are similar the latter species completes its life cycle in about eight days as compared to the eleven days of the former. *Amatellon* pupates naked within the galleries of the host whereas *Tetrastichus* pupates naked out side the galleries. The respiratory system of the immature stages is of typical Eulophid type. The percentage of parasitism is rather low and in 1956 season it was about 33%.

**34. Factors affecting the rate of reproduction of *Bracon brevicornis* Wesm. (Braconidae: Hymenoptera).**

K. S. NARAYANA, B. R. SUBBA RAO and RATAN LAL SHARMA, New Delhi.

*Bracon brevicornis* Wesm. is an important ecto parasite of the pink boll worm *Platyedra gossypiella* Saunders in India. For any successful utilisation of a beneficial parasite or predator in the biological control of insect pests, fundamental studies on insect parasitism and predatism is necessary. Rate of reproduction under laboratory propagation is an important factor to be considered. In this paper several factors, like physical and biological on the rate of reproduction of *Bracon brevicornis* have been described. The physical factors studied include temperature, humidity and light. Biological factors include density of host population, density of parasite population, quantity of food, adult nutrition, size of host and restraint on oviposition. The most marked effect on the rate of reproduction is by temperature and nutrition though humidity and some other biological factors also contribute to some extent.

**35. A contribution to the knowledge of the fecundity of *Chilo zonellus* Swinhoe under field conditions.**

K. S. NARAYANAN and R. N. KATIVAR, New Delhi.

The control of pests by means of their parasites, predators and other natural enemies is one of the most economical and effective method of control in applied entomology. In order, however, to utilise the method effectively the biology of the pest and its parasite has to be studied in detail both in the field as well as in the laboratory. Experiments in biological control sometimes have failed when these studies have been neglected. *Chilo zonellus* Swinhoe is one of the serious pests of maize (*Zea mays*) and juar (*Sorghum vulgare*) that are poor man's food in our country. Almost every year the pest causes serious damage to the millet crops. In this paper the fecundity of the pest has been studied in detail as it would enable us to have an idea of the population of the pest in the field.

The average fecundity of *Chilo zonellus* S. is  $228 \pm 29$  eggs. The average percentages of eggs laid on successive days is in the descending order, i.e., 40.59%, 27.9%, 17.28%, 8.07%, 5.58% and 0.52%. The monthly average fecundity is inversely correlated with the advancement of the season from July onwards as it is 298, 261, 247 and 139 eggs in the months of July, August, September and October respectively. The fecundity is directly proportional to relative humidity (within the range from 36% to 89%), whereas there exists no significant correlation between temperature (within the range from 72°F. to 85°F.) and the fecundity.

**36. The uses and potentialities of Radiotracers in Entomology.**

PAUL A. DAHM, Iowa State College, Ames, Iowa, U.S.A.

In entomology, as in other fields, the sensitivity of detection possible with radioisotopes has allowed considerable extension of research in such categories as :

(a) ecological and life history studies involving the tagging of insects and related arthropods with radioelements, (b) fundamental insect physiology studies, (c) biological effects of irradiation, (d) studies relating to medical and veterinary entomology, and (e) the use of labeled insecticides as a tool in modern insect toxicology. Examples of these uses are reviewed in this paper.

### 37. Storage of wheat flour in Piperonyl butoxide-Pyrethrins impregnated jute bags.

S. V. PINGALE, Mysore.

Insect free and insect infested whole meal wheat flour was stored in commercial 'B. twill' jute bags impregnated with different concentrations of Piperonyl-butoxide-pyrethrins and these bags were stored in trade ware houses. Insect contamination observed in the bags at fortnightly interval is shown and from the results even 30 mg. pyrethrin and 300 mg. piperonyl butoxide per sq. ft. is not considered enough to prevent infestation in insect free flour for a period of 2 months. Infested flour is seen to deteriorate in bags impregnated with various concentrations, unchecked. A trend that higher concentrations of the 2 insecticides might prove effective in preventing infestation to the flour stored in jute bags is revealed but cost of such impregnation is considered to be prohibitive.

### 38. Ethylene dibromide as a grain fumigant in the tropics.

S. V. PINGALE and M. MUTHU, Mysore.

It is shown that air-tight conditions are difficult to obtain in the tropical storage and at the same time because of the grains getting infested with insects in the field, fumigation to prevent losses in storage is essential. Ethylene dibromide having relatively a very low vapour pressure has therefore been tested for fumigation of grains and is shown to be a highly potent and cheap grain fumigant under tropical conditions. Sorption and retention of the chemical by a few cereal and pulse grains is determined and is shown to be of a very low order.

Commercial trials carried out with the chemical are referred to and it is shown that grain could be fumigated effectively with ethylene dibromide even in only partially air-tight stores or under polyethylene sheets.

### 39. Preliminary Studies on the Efficacy of Pestox 3 (Schradan) and Systox as Systemic Insecticides.

S. PRADHAN and S. K. DAS, Pusa, New Delhi.

This contribution reports the results of experiments carried out to determine the relative toxicity of Pestox 3 (Schradan) and Systox to *Rhopalosiphum pseudo-brassicae* (Davis), *Bagrada cruciferarum* Kirk, 4th stage hoppers of *Schistocerca gregaria* Forsk, and *Coccinella septempunctata* Linn.

Again *R. pseudobrassicae*, infesting potted plants of mustard (*Brassica campestris*) and cabbage (*B. oleracea*), the insecticides were used in irrigation water using 150 c.c.s of different concentrations in each pot containing 5 lbs. of soil. Both the insecticides were absorbed by the plants and killed the aphids on flowers and leaves. Systox proved to be more toxic than Pestox 3, the graphically determined values of L.C. 50 being 0.003890% for Systox and 0.008511% for

Pestox 3, 48 hours after treatment. Also in a field test in which 1 pint of different concentrations was applied to the base of each mustard plant Systox showed more rapid action against the aphids than Pestox 3. In another field experiment 20 c.c.s of different concentrations was sprayed on each cabbage plant infested with *R. pseudobrassicae*. Systox proved to be superior to Pestox 3, the graphically estimated values of L.C. 50 being 0.006607% for Systox and 0.03162% for Pestox 3. Systox also proved to have a fumigant action against *R. pseudobrassicae* whereas Pestox 3 did not show any fumigant action.

For tests against *B. cruciferarum*, each cabbage leaf was made to absorb 1 c.c. of a particular concentration through cut petiole and adults were allowed to suck the sap of such treated leaves. The graphically estimated values of L.C. 50 were 0.001059% for Systox and 0.03981% for Pestox 3. Also 2 square centimeter area of such treated leaves was fed to each 4th stage hopper of *S. gregaria*; Systox proved toxic but Pestox 3 showed no toxic action. The graphically estimated value of L.D. 50 being 0.2089 for Systox. Both the insecticides were also sprayed directly on *B. cruciferarum* and *C. septempunctata*. Systox proved to be more toxic than Pestox 3 as contact insecticide, the graphically determined values for Systox being 0.009354% against *B. cruciferarum* and 0.009057% against *C. septempunctata*.

#### 40. Comparative toxicity of modern insecticides to *Drosicha Mangiferae* Green (Coccidae : Hemiptera.)

S. PRADHAN, M. G. JOTWANI and B. K. RAI, New Delhi.

The bioassay of laboratory made insecticide emulsions with nymphs of *Drosicha mangiferae* Green as test insect, showed that chlordane, deldrin, isodrin, aldrin, lindane and endrin were less toxic than p'-p' DDT, i.e., 0.169, 0.205, 0.271, 0.339, 0.376 and 0.749 times respectively as toxic as pp DDT. Malathion proved to be more toxic than p'-p' DDT being 11.882 times as toxic as DDT. Four commercial formulations were also tested. Out of these the formulation of nicotine sulphate was seen to be less toxic i.e. 0.10 times as toxic as the laboratory made emulsion of p'-p' DDT, while the formulations of parathion, systox and diazinone proved to be more toxic i.e. about 36, 6 and 3 times respectively as toxic as p'-p' DDT.

#### 41. Evolution of control schedule for mustard aphid.

S. PRADHAN, M. G. JOTWANI and P. SARUP, New Delhi.

The mustard aphid *Rhopalosiphum pseudobrassicae* Davis is a serious pest of mustard crop. The object of the present investigations was to work out the details of control operations with different insecticides which will keep the aphid population at the minimum level. The insecticides tried were: (a) Nicotine sulphate 0.1% (substituted by diazinone (basudin) 0.025% after second spraying), (b) Gamma BHC 0.1%, (c) Pestox 0.1%, (d) Aldrin 0.1% to 0.2%, (e) Dieldrin 0.1 to 0.2%, (f) Nicotine sulphate (substituted by basudin)+gamma BHC, (g) control (no treatment).

Three spraying were necessary between 18-10-1955 to 12-3-1956 in the case of Pestox and gamma BHC. Four sprayings in the case of nicotine sulphate (or basudin) and gamma BHC mixture and five sprayings in the case of nicotine sulphate or basudin, aldrin and dieldrin. The average yield of mustard seed per plot was: Pestox—11 lb.; gamma BHC—8 lb., 14.3 oz.; nicotine sulphate (or

basudin)+gamma BHC—6 lb., 14.6 oz.; nicotine sulphate (or basudin)—5 lb., 11.2 oz. Dieldrin—5 lb., 10.5 oz.; Aldrin—2 lb., 12.2 oz. and Control—1 lb., 5.1 oz.

**42. Comparative Stomach Toxicity of Four Modern Insecticides to the Different Stages of the Desert Locust, *Schistocerca gregaria* (Forsk.).**

S. PRADHAN and S. D. MISHRA, Pusa, New Delhi.

The hoppers consumed the largest quantity of food during the middle period of each instar. In the adult stage the feeding capacity of locust remained highest during the first fortnight. In order to determine exclusively the stomach toxicity, the poisons were fed to the hoppers by sandwich technique. There was increase in resistance in higher instars and there was a sudden enormous increase in resistance to stomach poison when the fifth stage hoppers moulted into the adult stage. Also in the same instar the resistance to stomach poison increased with the increase in body weight. Taking the resistance of 2nd stage hopper as unit the relative resistance of 3rd, 4th, 5th and adult stage was found to be 2.6, 5.4, 9.9 and 66.0 respectively. The order of toxicity of different insecticides used was found to be dieldrin>aldrin>lindane>endrin. Taking the toxicity of lindane as unit the relative toxicity of aldrin, dieldrin and endrin was found to be 7.1, 8.6 and 0.9 respectively.

**43. The surface Grasshopper Epidemic in the Punjab, 1956.**

SARDAR SINGH, Punjab, Ludhiana.

Surface grass-hoppers assume epidemic form during certain years in the riverine tracts of the Amritsar, Gurdaspur, Hoshiarpur and Kangra districts of the Punjab during the summer months. The major species are *Oxya bidentata* Walker, *O. multidentata* Will, *Aelopus tamulus* Fabricius, *Acrida exaltata* Linnaeus and *Chrotogonus trachypterus* Blanchard. Species like *Locusta donica* Linnaeus and *Euprepocnemis alacris* Servilla are encountered in small numbers. *Hieroglyphus nigrorepletus* Bolivar and *H. banian* Fabricius appear in *jowar* and paddy during the monsoons.

*Oxya* spp. and *Aelopus* sp. appeared in epidemic form in the middle of May in *berseem* (*Trifolium alexandrinum* Linnaeus) and little seed could be procured. Later they migrated to paddy nursery, maize and *jowar* (*Sorghum vulgare* Pers.) fodder, cotton and sugarcane. Paddy nursery, maize and jowar fodder and cotton had to be resown in many places. Germinating cotton was also attacked by *Chrotogonus* sp. The sugarcane leaf lamina was almost totally devoured and reduced to the midrib. Mating in *Oxya* spp. was observed in the second fortnight of June, and nymphs in large numbers were met with in July. With the abundant growth of grass due to monsoons the population of the second germination spread over wide areas. *Hieroglyphus banian* and the third germination of *Oxya* sp. have concentrated on paddy in September.

The Punjab Plant Protection service treated 1392 acres of various crops in these districts on cost with BHC 10% dust and BHC 0.2% suspension with successful results. But as the pest migrates to the treated crop from nearby untreated fields the Punjab Government sanctioned issue of insecticides worth Rs. 25,000/- free of cost for the control of these grasshoppers. Under this programme another 47,920 acres were cleared of these pests. In addition, field trials with Chlordane (2 lbs. actual) suspension, aldrin (4 ozs. actual) emulsion and Dieldrin (4 ozs. actual) suspension at the rate of 50 gallons per acre, gave 90-95% kill in the case of nymphs of *Oxya* spp., *Aelopus* sp., *Acrida* sp. and *Chrotogonus* sp.

**44. Observations on *Ctenomeristis ebriola* Meyrick (Pyralidae).**

G. C. SENGUPTA, B. K. BEHURA and G. D. ROUT.

Since 1953 mango fruits have been found to be damaged by the larvae of the Pyralid, *Ctenomeristis ebriola* Meyrick in some parts of Puri in Orissa. This is the first record of this Pyralid as pest of mango in India. Earlier in 1934 this Pyralid was bred by Hutson from the larva boring in stems of seedlings of *Anacardium occidentale* in Gampola, Ceylon. Experimental work was undertaken to study this Pyralid and to evolve a suitable control measure. A short account of the life history, habits, distribution, control measure, nature and extent of damage to mango in Orissa has been given.

*C. ebriola* completes its life cycle in 23 to 25 days under laboratory conditions at Bhubaneswar. The eggs are laid in masses on the peel of the fruits. The egg stage lasts for 4 days. The larval period varies from 10 to 12 days. The larva undergoes 4 moults before pupation. The pupal period lasts for 9 days. Mangoes of different sizes are attacked by the caterpillars. Up to 4 caterpillars are found in one mango fruit but a few are sufficient to cause the fruit to decay. The young caterpillar usually bores the fruit at the anterior end and feed first on the pulp, later on the seed which is damaged. The infestation of fruits ranged from 4.2% to 25%.

Three sprayings of Dieldrin 50% W.P. (in terms of 4 lbs. of active ingredient per 100 gallons of spray) were done on mango fruits before infestation at the interval of 15 days to study its effect. The untreated fruits of trees in adjacent rows were infested by these border caterpillars. As the caterpillars pupate in the soil, the soil round about the trees should be raked up to kill the pupae.

**45. Bionomics and cultural control measures of *Apsylla cistellata* Buckton.**

A. C. SEN, Sabour (Bihar).

The distribution of *Apsylla cistellata* Buckton, under Bihar condition has been studied and the pest infestation has been found to be on the increase in alarming proportion in wider areas of the State.

The bionomics of the pest has been studied. The pest has been found to emerge from the galls in the month of March; oviposition period lasts during the whole of March, incubation period from April to August, nymphal period from August to February. The mode of egg-laying, the methods of emergence of the fly from the galls have been studied in detail.

"Zardalu", "Malda" and "Bombai" mango varieties have been found susceptible and "Gulabkhas", "Hinsagar" and "Bathua" varieties almost resistant. Grafted varieties are more prone to the attack. No suitable control method with the insecticides has yet been found. Removal of the galls in the month of December from all the trees in an orchard has been, however, found to be very effective to check the pest devastation and this method further initiates heavy flowering and consequently good fruiting.

**46. Control of Paddy stem borer (*Schoenobius incertellus*).**

A. C. SEN, Sabour (Bihar).

Pot-trials and Field-trials were undertaken in Bihar to test the efficacy of Folidol E-805 and Endrin, both as a preventive and curative measures of control of the Paddy Stem borer. The insecticides in 0.04% dilution were used.

Results obtained in pot-trials showed that the freshly hatched larvae were killed by the effect of these insecticides, if they tried to penetrate inside the stem within 6 days of the treatment of the crop. Further, it was found that high percentage of the mortality of the borer larvae upto 10 days old, are brought about by the use of the insecticides and with the increase of age of the larvae, the mortality percentages went on declining.

Randomised replicated field trials showed that three sprayings of either of these insecticides are effective in minimising the population of the pest to a great extent. Regulating the time of insecticidal operation to get maximum benefit out of the minimum cost, is still under experimental stage, but it opens a new line of controlling the pest.

#### 47. Bionomics of the Paddy Gall Midge in Bihar.

A. C. SEN, Sabour (Bihar).

The attack of paddy gall-midge (*Pachytiplosis oryzae* Mani) is confined only to Chotanagpur plateau in Bihar. Detailed field studies have revealed that the pest thrives over the off-season period of paddy fields. Five of such plants have been successfully established as the secondary host-plants to the pest. The name of these plants are stated below.

Local name	Botanical name.
1. Doro.....	<i>Hemarthria compressa</i> R. Br.
2. Mauna.....	<i>Paspalum scrobiculatum</i> L.
3. Kowa pasra.....	<i>Oryza sativa</i> L. (Wild variety).
4. Dub .....	<i>Cynodon dactylon</i> Pers.
5. Pahrar.....	<i>Bothriochloa pertusa</i> (Wild) A. Cam.

Varietal resistance studies against this pest have shown that paddy varieties with rough and hard stem like the *Neta* and *Bhainsa* were less susceptible to the attack, as compared to *Dahia*, *Bachha kalma*, *Dhusri*, *Tilsar* and *Gora*. These varieties are commonly grown in Chotanagpur areas.

#### 48. Control of Bathua weed (*Chenopodium album*) with 2, 4-D.

A. S. SRIVASTAVA, A. P. SAXENA and R. L. GUPTA, Kanpur.

Weed is a very important problem in India. Uptil now there is not a single weedicide which has been found very effective against certain important weeds. Trials have been undertaken to find out the effect of 2, 4-D or Fernexone against one of the common weeds, Bathua (*Chenopodium album*), which is found very commonly associated with wheat plants in U.P. This weed is particularly reported to be very serious problem in the Dehradun district. Experiments undertaken both at Kanpur and Dehradun have clearly indicated that 0.15% concentration of 2, 4-D or Fernexone has controlled bathua weed very successfully, but, at the same time did not produce any phytotoxic effect on the wheat plants or the wheat grains.

#### 49. The use of insecticide-fertilizer mixture against Termites.

C. THAKUR, Pusa.

Three common termite species such as *Microtermes obesi*, *Odontotermes assmuthi* and *Coptotermes heimi* have been found to damage sugarcane crop in

Bihar. Tests were designed by conducting a field experiment during 1954-55 on calcareous soil at Pusa, to find out whether dieldrin mixed with fertilizers can be equally effective as when applied alone against termites. B.H.C. was also included in the experiment to get an idea of comparative efficacy. Recommended doses of dieldrin and B.H.C. were used.

The use of dieldrin mixed with fertilizers proved most effective. It was found to be superior to that dieldrin being used alone. There was hardly any difference between yields of sugarcane plots from untreated plots and plots treated with B.H.C. besides latter showing phytotoxic effect on buds and plants of the cane crop. It was thus evident that dieldrin could be used profitably when mixed with fertilisers and thus reduce the cost of cultivation of sugarcane per acre besides making the whole operation so easy for the cultivators.

### BIOCHEMISTRY AND ORGANIC CHEMISTRY

#### 50. Role of Amino-acids in the process of clarification of sugar-cane-juice and manufacture of sugar. Part I—Identification of different amino-acids in periodic samples of cane-sugar-juices.

B. C. BANERJEE, Kanpur.

Nitrogenous bodies play an important role in the process of cane-juice clarification and sugar manufacture. Zerban accounted that 60% of the nitrogen present in cane-juice passed through the defecation process, which he termed as objectionable nitrogen. Of this about 50% could be considered as being made up of amino-acids and their amides. Browne and Blocin also observed that 55% of the nitrogen present belong to the amino-acids and their amides. It is therefore expected that these amino-acids would play an important role in the clarification of cane-juice and hence sugar manufacture.

An attempt has been first made, to test qualitatively the various amino-acids present in different periods of cane-life.

Periodic samples are drawn from the field in different months taking care that the samples are representative as far as possible. Juices are extracted by three-rollers crusher and their amino-acid content are identified by paper chromatograms. It has been observed that the number of amino-acids gradually increased and at the harvest time, nine different amino-acids could be detected.

Further work is in progress.

#### 51. Retention of added Ascorbic Acid in canned Jack Fruit during processing and storage.

B. S. BHATIA, G. S. SIDDAPPA and GIRDHARI LAL, Mysore.

In the course of a systematic investigation of the stability of ascorbic acid in various canned products, data regarding retention of added ascorbic acid during processing and storage have been collected in the case of canned jack fruit (*Artocarpus Integrifolia*) fortified with 50 mg% of the vitamin. The results show that about 80% of the vitamin is retained after processing. During storage at room temperature (24-30°C) for 24, 48 and 64 weeks, the retention is 49, 37 and 30% respectively. At 37°C, the corresponding values after 24 and 48 weeks are 28 and 2% respectively. Stability of ascorbic acid is rather low in canned jack fruit when compared with other commercially important fruits.



**52. Nicotine content in Tobaccos.**

S. C. MEHTA and C. DAKSHINAMURTI, New Delhi.

Nicotine content in 32 tobacco collections grown at the Indian Agricultural Research Institute, New Delhi was estimated by the absorption spectrographic method. Its value in the Rustica collections, varied from 2.0% to 4.02% while in the rest of the collections it was below 2.0%. Nicotine content in the stems was comparatively less.

**53. Chemical composition and nutritive value of Bowar (*Cassia tora*) silage.**

S. J. DANIEL and N. D. Kehar, Izatnagar.

Bowar (*Cassia tora*) is a leguminous plant and grows in rainy season. It is not eaten as such by the animals. The plant was ensiled with molasses. The percentage composition on dry matter basis was found to be : organic matter 89.88; crude protein, 12.75; ether extract, 1.53; crude fibre, 35.89; nitrogen free extract, 39.71; total carbohydrate, 75.60; total ash, 10.12; calcium (CaO), 2.68 and phosphorus ( $P_2O_5$ ), 0.80.

To determine the nutritive value a digestibility trial was carried out on six Kumaoni bullocks. The silage was fed *ad lib*. The experimental animals on an average consumed 2.38 lb. silage (on dry basis) per 100 lb. body weight per day. The digestibility coefficients were as follows : organic matter, 45.73; crude protein, 28.54; ether extract, 52.84; crude fibre, 40.38; nitrogen free extract, 55.86; and total carbohydrate, 48.92. The digestible crude protein, total digestible nutrients and starch equivalent value in lb. per 100 lb. of the dry silage were found to be 3.63, 42.10, and 20.79, respectively. The experimental animals maintained their weights and showed positive balances for nitrogen, calcium and phosphorus.

The results indicate that Bowar (*Cassia tora*) plant can be utilized as cattle feed by ensilage. The silage forms a maintenance ration for Kumaoni bullocks.

**54. Chemical composition and nutritive value of Kusondi (*Cassia occidentalis*) silage.**

S. J. DANIEL and K. SAHAI, Izatnagar.

Kusondi (*Cassia occidentalis*) is a leguminous plant, and is available in abundance during monsoons. It is not eaten by the animals as such. In order to utilize this plant as cattle feed it was ensiled with molasses. The percentage composition of the silage (on dry matter basis) was found to be : organic matter, 88.23; crude protein, 15.81; ether extract, 3.49; crude fibre, 35.99; nitrogen free extract, 32.94; total carbohydrate, 68.93; total ash, 11.77; calcium (CaO), 2.56; and phosphorus ( $P_2O_5$ ), 0.75.

A digestibility trial was carried out on six kumaoni bullocks. The silage was fed *ad lib*. The bullocks on an average consumed 1.9 lb. of silage on dry matter basis, per 100 lb. of body weight. The digestibility coefficients were as follows : organic matter, 47.10; crude protein, 43.24; ether extract, 61.03; crude fibre, 43.34; nitrogen free extract, 51.51; and total carbohydrate, 47.22. The digestible crude protein, total digestible nutrients and starch equivalent value in lb. per 100 lb. of the dry material were found to be 6.83, 44.14 and 22.14, respectively. The animals showed positive balances for calcium, phosphorus and nitrogen.

The results show that Kusondi (*Cassia occidentalis*) plants can be utilized as cattle feed by ensilage. The silage can form a maintenance ration for bullocks.

**55. Effects of Hormones on the ripening of fruits.**

W. B. DATE and P. B. MATHUR, Mysore.

Recent researches have shown that hormones can be used either to retard or accelerate the rate of ripening in fruits during storage. Effects of 2 hormones, viz., 2, 4, 5-trichlorophenoxyacetic acid and maleic hydrazide, on the ripening of oranges and mangoes have been studied. It was observed that the temperature of storage is an important factor in determining the type (whether retardation or acceleration of ripening) of the hormonal action. The physiology of these hormonal actions has not been investigated in detail so far. It appears probable that hormones in some way affect the production of ethylene, which is the direct ripening stimulant.

**56. Some studies in the utilization of Jack Fruit wastes as a source of Pectin.**

N. L. JAIN and GIRDHARI LAL, Mysore.

Investigations undertaken to explore the possibilities of utilizing indigenous raw materials as sources of pectin, which is in great demand in the country, have revealed that jack fruit (*Artocarpus integrifolia*) wastes (inedible portion comprising peels, cores and skins) can be profitably and satisfactorily utilized for this purpose. These constitute about 45% of the total fruit weight and contain about 2.4 to 4.1% pectin (as calcium pectate) on fresh weight basis. As a result of studies reported in the present paper, a method has been standardized for the preparation of pectin. The material is first leached and washed thoroughly, accompanied by partial decolorization and restoring of normal colour in case of the material browned on prolonged exposure to the atmosphere. Pectin is then extracted at boiling temperature using N/60 to N/50 HCl as the extractant. The extract obtained is clarified by a simplified procedure involving sedimentation, straining and centrifuging in a Sharples Super Centrifuge. This is followed by concentration under vacuum, separation of pectin by precipitation with alcohol, followed by drying and powdering. The yield on fresh weight basis varied from 1.5 to 2.0% (1.8 to 2.4% in terms of 150 jelly grade).

**57 Chemical composition and nutritive value of Imperata cylindrica grass, II. Early green stage.**

N. D. KRISHNAN and M. M. JAYAL, Izatnagar.

In view of the low consumption of *Imperata cylindrica* grass hay at the flowering stage it was thought desirable to study the grass in the early green stage of growth.

The percentage composition of the grass (on dry basis) was found to be : crude protein, 4.69; ether extract, 1.52; crude fibre, 38.14; nitrogen-free-extract, 49.33; total carbohydrates, 87.47; ash, 6.32; calcium (CaO), 0.71 and phosphorus ( $P_2O_5$ ), 0.34.

A metabolic trial was conducted on six Kumaoni bullocks. Unlike the hay in the flowering stage the green grass was relished by the animals and the animals, on an average, consumed 896.48 gm. or 1.98 lb. grass (on dry basis) per 100 lb. body weight per day.

The average digestibility coefficients of crude protein, ether extract, crude fibre and nitrogen-free-extract were found to be : 33.72, 40.47, 58.67 and 55.20 respectively. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of the dry material, were found to be 1.60, 52.86 and 30.42 respectively.

The animals recorded positive balances for nitrogen, calcium and phosphorus and maintained good health throughout the feeding regime.

**58. Chemical composition, digestibility and nutritive value of *Jharberi* (*Zizyphus nummularia*) leaves.**

N. D. KEHAR, M. M. JAYAL and K. SAHAI, Izatnagar.

*Jharberi* is a small shrub which grows extensively in the arid regions of U.P., Punjab, Western Rajputana, Kutch, Kathiawar, Gujrat and Khandesh.

The percentage composition of leaves (on dry basis) was found to be : crude protein, 11.63; ether extract, 1.69; crude fibre, 33.82; nitrogen-free-extract, 46.76; total carbohydrates, 80.58; ash, 6.20; calcium (CaO), 2.66 and phosphorus ( $P_2O_5$ ), 0.70.

To determine the digestibility and nutritive value, a feeding trial was conducted on sheep. *Jharberi* leaves formed the sole feed. The animals relished the leaves and, on an average, consumed 3.28 lb. leaves (on dry basis) per 100 lb. body weight per day.

The average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen-free-extract were found to be : 46.88, 28.46, 54.35 and 69.00 respectively. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of leaves on dry weight basis were found to be : 5.45, 57.10 and 37.00 respectively.

The experimental sheep displayed positive balances for nitrogen, calcium and phosphorus.

The observations show that *Jharberi* leaves are quite palatable and nutritious.

**59. Palatability, chemical composition and nutritive value of *Bans* (*Dendrocalamus strictus*) leaves.**

N. D. KEHAR and M. M. JAYAL, Izatnagar.

The percentage composition of *bans* leaves (on dry basis) was found to be : crude protein, 14.19; ether extract, 1.73; crude fibre, 27.64; nitrogen free extract, 44.46; ash, 11.98; CaO, 1.57 and  $P_2O_5$ , 0.59.

To determine the nutritive value of *bans* leaves a metabolic trial was conducted on six sheep. The leaves formed the sole feed of the test animals. The animals ate the leaves with great relish and consumed, on an average, 2.51 lb. of leaves on dry matter basis per 100 lb. body weight per day.

The average digestion coefficients for crude protein, ether extract, crude fibre and nitrogen free extract were found to be 65.83, 34.13, 57.52 and 50.26 respectively. The digestible crude protein total digestible nutrients and starch equivalent values in lb. per 100 lb. of dry matter were 9.34, 48.91 and 32.12, respectively.

The experimental sheep maintained weight during the course of the feeding trial and exhibited positive balances for nitrogen, calcium and phosphorus.

It may be concluded from the above observations that *bans* leaves are fairly rich in the essential nutrients and form a maintenance ration by themselves.

**60. The digestibility of para grass (*Brachiaria mutica*) by the Chromium ratio method.**

J. SEN GUPTA and R. CHANDA, Haringhata.

The digestibility of para grass which apparently seem to have a good prospect as a fodder, has been determined by the indirect method using chromium sesquioxide as an indicator of equivalence of faeces and food. The experiments were designed to find the digestibility coefficients of various nutrients in cows and in buffaloes. It was found that there is no significant difference between the species in respect to the digestibility figures of any of the constituents. D.C.P. and S.E. calculated

from the mean digestibility of the cows & buffaloes were 0.94 and 6.69 on fresh basis, and 4.46 and 31.67 on dry basis. A comparison of the nutritive value of para grass with some other feeding stuffs showed that para grass is a low quality roughage which can be used as a maintenance ration, but is incapable of being used as a production ration.

## PLANT BREEDING, GENETICS, CYTOGENETICS, PLANT PATHOLOGY AND HORTICULTURE

### 61. Effect of photoperiod treatment on certain varieties of *Nicotiana rustica*.

RALABHADRA MISRA and LOKANATH MAHAPATRA, Bhubaneshwar.

The effect of photoperiod treatment on two varieties of *Nicotiana rustica* (i.e. S. 20 and N.P. 70) was reported. Three sets of plants of each variety were transplanted into pots containing soil and compost (1:1). Short day treatment of 8 hours sun light daily (from 7 A.M. to 3 P.M. were given to 47 days' old seedlings until flowering commenced. Another set was exposed to continuous light treatment by arranging artificial light during night through a 500-watts bulb fixed five feet away. The third set was kept as control.

It was observed that S. 20 (a variety of "Bidi" tobacco) gave equal response to both short day and long day treatments, showing thereby that a mere change in the day length is enough to induce appreciable earliness in flowering compared with the control.

N.P. 70 (a variety of "chewing" tobacco) showed much greater response to the long day treatment than to the short day treatment. Therefore N.P. 70 has been classed as a long day plant. Hitherto, only short day and indeterminate varieties were recorded in the genus *Nicotiana*.

Short day treated plants were shorter and of poorer growth than long day treated plants and the control plants. The weight of first four succured leaves was considerably higher in the long day treated plants than that of the short day treated or control plants. This phenomenon can be of economic importance, as continuous light treatment can induce higher yield of leaves.

Symptoms of iron deficiency appeared in the short day treated plants within ten days of the commencement of the treatment. The chlorotic plants recovered when these were irrigated with a solution of 0.05% ferrous ammonium sulphate at the rate of 25 c.c.s. per plant. However, the symptoms appeared again subsequently. A second instalment of irrigation resulted in the recovery of the chlorotic plants for the second time. The short day treated plants are unable to assimilate the iron present in the soil, perhaps due to the excretion of some substance which converts the ferrous iron contained in the soil to insoluble ferric form. That the soil is not deficient in iron is clear from the fact that the long day treated and the control plants grown in similar soil do not show such symptoms.

### 62. Line pattern, a virus disease of plums in Kumaon.

K. S. BHARGAVA and N. S. BIST, Nainital.

Line pattern, a virus disease of plums was first observed in Ranikhet and Ramgarh orchards in 1955 in different varieties of plums. Symptoms produced by the disease include chlorotic lines and yellow to creamy white vein-banding leading to a network on the leaves. Sometimes oak-leaf-like patterns are also formed. The presence of virus was confirmed by transmitting the disease by budding and grafting. This is the first record of this disease in the country.

**63. Paddy troubles noticed under ill drained conditions and heavy manuring.**

D. BAP REDDY, Hyd.-Dn.

In recent years complaints of an unknown disease of Paddy have been received. The tips dry up and assume a brownish colour similar to Itkarogum. (*Curvularia lunata*). The disease occurs in patches are suddenly the plants begin to die. The duration of the disease is about 2 weeks and mostly one month after transplanting.

The symptoms appear as drying up of tips of leaves. The leaves stand erect and do not bend. The whole clump some times dries up. When the plant is uprooted roots appear shingling dark and sulphide odour could be easily smelt. When the roots are washed in clean water and exposed to atmosphere they assume the colour of reddish white, the colour of healthy roots. Or when the roots of affected plants are placed in a dish containing dilute HCl, the odour of  $H_2S$  can easily be smelt and roots assume their original colour.

This disease has been noticed in low lying areas, where drainage is impeded and that too mostly during the Tabi season (December to April). It becomes very severe and intensive in the fields where high nitrogen fertilisers of ammonium sulphate sources have been used. In many places where drainage is impeded and water is not plenty and the paddy is grown under Japanese method of cultivation, sulphide injury may be suspected.

The spread of the disease has been checked by adopting the following control measures. The affected fields should be flooded and a thorough mixing of soil or mulching should be done either by hand or by weeder. Then the fields should be drained until slight cracks appear. This treatment may be repeated two or three times. Drains around the affected fields should be made to increase drainage.

**64. Difference in the manifestation of heterosis between the reciprocal hybrids in *Nicotiana rustica*.**

BALABHADRA MISRA, Bhubaneswar.

Difference in the manifestation of heterosis with respect to height of plants was observed between the reciprocal hybrids of two varieties of *Nicotiana rustica* for two consecutive seasons. The progressive height measurements of parents and hybrids have shown (i) that the early flowering short parent grows faster than the late flowering tall parent; (ii) that the rate of growth of the hybrids is not higher than that of the parents in the early stages, but the same increases at a later stage, thus manifesting heterosis; (iii) that there is a significant difference in the mean height of the reciprocal hybrids. It has been concluded (i) that a certain minimum height should have to be attained by the plants before flowering commences and (ii) that heterosis manifestation is not necessarily due to the initial advantage gained by the bigger embryo of the hybrid seed and (iii) that the reciprocal difference in the manifestation of heterosis is due to the cytoplasmic influence. The presence of cytoplasmic influence in the inheritance of quantitative characters complicates the situation, which, by itself, is complex enough due to the semblance of non-heritable effects with the heritable effects.

**65. Association of change in phyllotaxy with the occurrence of Tricotyly in some plant species.**

BALABHADRA MISRA, Bhubaneswar.

Seedlings with three cotyledons (Tricots) sometimes occur in an otherwise dicot population. These tricots are invariably associated with the change of phyllotaxy in the plant concerned and may also be partially or completely sterile. The author

reports three cases of such association e.g., *Crotalaria juncea*, *Dolichos lablab* and *Linum usitatissimum* and has referred to two other cases reported by him earlier e.g., *Zinnia peruviana* and *Antirrhinum majus*. Some of the above tricots turned out to be mutants. It is suggested that the isolation of tricots in an otherwise dicot population followed by a more concentrated attention to these is an easy method of detecting mutants. If this method is proved successful, the rate of mutation in Nature may be found much higher than what it is taken to be. This higher rate of mutation may, in turn, lead to revision of the present concept of evolution.

**66. Different Techniques to raise Hybrids from Crosses of *Lycopersicon esculentum* and *Lycopersicon peruvianum*.**

B. CHOWDHURY, Pusa, Bihar.

*L. peruvianum* which has proved to be resistant to most of the diseases also contains about three times more vitamin C than *L. esculentum*. The difficulty of transferring these resistant genes to the common tomato is the cross-sterility of *L. peruvianum* with *L. esculentum*. When *L. esculentum* is pollinated by *L. peruvianum* apparently normal fruit development takes place, normal seed development however, does not occur. The mature fruit contains minute collapsed ovules. The reciprocal crosses are not successful. Work was started in 1952 to try different techniques to raise hybrids of *L. esculentum* and *L. peruvianum* crosses. The techniques used were (1) Embryo culture, (2) Application of growth hormones, (3) Interspecific grafting, (4) Mixed pollination, (5) Crossing *L. esculentum* with *L. peruvianum* var. *Dentatum*, (6) Crossing *L. esculentum* with the hybrid of *L. peruvianum* and *L. peruvianum* var. *Dentatum* and (7) Crossing tetraploid *L. esculentum* with diploid *L. peruvianum*.

Embryo culture technique proved to be successful in growing some hybrid plants from crosses between *L. esculentum* and *L. peruvianum* p-chlorophenoxy acetic acid, 15 to 20 ppm. gave some encouraging results in the post-fertilization spray. Greater number of large seeds from which excised embryos can be grown on the agar media, were obtained when sprayed with CIPA. Post-fertilization sprays of  $\alpha$ -naphthelene acetic acid (50 ppm.) and  $\beta$ -naphthoxy acetic acid (50 ppm.) did not have any effect on the seeds of the hybrid fruit. Grafting of *L. esculentum* and *L. peruvianum* done either way at a very early seedling stage did not have any effect on the results of hybridization. Crosses between *L. esculentum* with mixed pollens of *L. esculentum* and *L. peruvianum* did not help in getting a hybrid plant. Crosses between *L. esculentum* and *L. peruvianum* var. *Dentatum* did not give any viable seed. The same was the result when *L. esculentum* was crossed with the hybrid of *L. peruvianum* and *L. peruvianum* var. *Dentatum*. Viable sesquidiploid seedlings were obtained from the cross between tetraploid *L. esculentum* and diploid *L. peruvianum*. The F<sub>1</sub> plants were vigorous and were intermediate in character of the two parents.

**67. A new seedling blight of Jute.**

T. GHOSH, B. C. KUNDU and N. MUKHERJEE, Barrackpore.

In the district of Hooghly, Howrah and Burdwan jute as a Kharif crop is mostly followed by potato. Disease of jute are more prevalent in such jute-potato fields and the annual loss of the crop from seedling blight, stem rot, root-rot and wilt have been estimated to be about 11 per cent. *Macrophomina phaseoli* (Maubl) Ashby has so long been known as the only pathogen causing these diseases of *C. capsularis*

and *C. olitorius*. Recently other fungi namely *Ozonium* species, *Chaetomium* sp. and a number of species of *Fusarium* and a bacteria *Pseudomonas* sp. have also been found to be associated with these diseases. The pathogenic property of each of these microorganisms is being worked out. A detailed investigations on seedling blight in jute-potato fields have been carried out. It has been found that the species of *Ozonium* which is distinct from *O. omnivorum* (Shear) Duggar is a virulent pathogen on *C. olitorius* seedlings. Its role in association with *Macrophomina phaseoli* and other fungi isolated from jute, in relation to root-rot and wilt in jute fields is being worked out.

**68. Cytology of a few low sterile plants in tobacco *Nicotiana tabacum*.**

D. M. GOPINATH, Veda-sundar.

In the varieties *Immer Spanish*, *Comstock Spanish*, *Pennsylvania seed leaf-Guider*; *Connecticut broad leaf Comstock Spanish*; and *Havana 142* a few plants which were showing low pollen sterility were cytologically analysed.

Cytological studies revealed in some of the microsporocytes bridges and fragments during anaphase I. Diakinesis appeared normal and showed 24<sup>1</sup> in all plants analysed. The percentage of microsporocytes showing aberration was in the range of 5 to 17. Even though in *Comstock Spanish* the percentage was as low as 3.75, the percentage pollen abortion was on an average 18.5.

It has been deduced that the probable cause of low sterility is paracentric inversions.

**69. A cytological study of the post embryonic development of the salivary glands in *Lygaeus kalmii angustomarginatus* Parshley.**

C. MARY JOHN, Trivandrum.

A cytological study of the post embryonic development of the salivary glands in *Lygaeus kalmii angustomarginatus* shows that during the five instars of its development polyploidy is an important factor.

In the first instar, the gland is composed mostly of diploid cells but there are some tetraploids and octoploids. The polyploidy reaches the highest degree in the early fifth instar when 8192-ploid nuclei are present. The early stage of each instar, from the second instar onwards, has a higher degree of polyploidy than the corresponding late stage of the same instar. The highest degree of polyploidy observed in the imago is 2048-ploid.

From the second instar onwards, the nuclei of the above tissue are more deeply staining in the late instars than in the early instars. The growth of the above organ is due to an increase in the number of cells resulting from amitosis and to an increase in the size of the cells resulting from endomitosis. Mitotic divisions were never seen in the above tissue in the post embryonic stages.

The presence of the Y chromosome complex is an identifying character of the resting stage and of the amitotic stages. It is suggested that amitosis is not degenerative but a sign of active metabolism and may be concerned with the increase of nuclear surface in order to restore the ratio between nuclear surface and nuclear volume required for the proper metabolism of the cell. The observations on the relationship between endomitosis and amitosis in the above tissue seem to indicate



that amitosis is a type of somatic reduction by which the polyploidy is halved at each nuclear division. This is supported by the hypothesis of Geitler (1939, *Chromosoma*, 1) that endopolyploidy and amitosis may be related and the observations of Berger (1936, *Anat. Rec.*, 67) and Grell (1950, *Die Naturwissenschaften*, 37).

#### 70. Chemical treatment for controlling loose smut of wheat.

R. S. MATHUR, J. S. JAIN and S. C. MATHUR, Kanpur.

The chemical control of loose smut of wheat, an internally seed-borne disease, was attempted by the method employed by Tyner (1953) in his studies in Canada. The inoculated seeds of varieties Pb591, NP4, NP52 and NP720 in 1945 and Pb591 and NP12 in 1955 were soaked in ordinary tapwater for 6 hours and thereafter immersed in 0.1 per cent Spergon (Wettable) suspension for 24 hours at room temperature (1954 : 72-78°F and 1955 : 71.6-77°F). In the 1954-55 trial, Spergon treatment gave complete control in varieties Pb591, NP52 and NP720 whereas their control had shown 12.6, 20.9 and 18.5 per cent infection respectively. In variety NP4, the infection was 5.1 and 29.2 per cent in treated and control rows respectively. During 1955-56, loose smut infection was 5.1 and 2.0 per cent in Spergon treated seeds of Pb591 and NP12 respectively. The respective infection in control was 31.9 and 10.4 per cent. No marked reduction in germination of treated seeds was observed in these trials.

#### 71. Varietal resistance of Barley to loose smut (*Ustilago nuda* (Jens) Rostr.).

R. S. MATHUR and S. C. MATHUR, Kanpur.

Loose smut of barley sometimes causes appreciable damage. In variety NP21, natural infection up to 25 per cent was observed at Bahraich during 1955-56. On an average 1,000 tons of barley can be lost due to this disease in Uttar Pradesh if the infection is only 0.1 per cent.

With a view to evolve varieties resistant to loose smut a number of promising varieties have been tested since 1952-53 by the 'partial vacuum method' at the flowering stage. So far 35 varieties have been tested. Artificial infection up to 62.5 per cent was obtained in variety I.W. 112/B-5 of Russian origin. More than 40 per cent infection has been obtained in varieties NP21, C251, K3, K14 and J.B.S. 21, a variety from Rajasthan. Varieties C50, J.B.S. 30 and Ramni showed infection of 5 to 10 per cent and variety I.W. 112/B-2 of Russian origin escaped the attack of loose smut. On account of its fair tolerance to loose smut and desirable agronomical characters variety C50 has been released for cultivation in Bareilly district.

#### 72. Studies in freezing of fruits and fruit juices.

P. B. MATHUR, K. KIRPAL SINGH and H. C. SRIVASTAVA, Mysore.

Commercial freezing of fish was started in India after the World War II. It is estimated that the few commercial freezers now in operation in this country have a combined storage capacity of nearly 300 tons of fish. However, no work on the freezing of fruits and fruit juices has been reported in India and neither these commodities have been commercially frozen yet. Work done in connection with the freezing of apple, cashew apple juice, grapes, jackfruits, litchi, mango, orange and pineapple is described and discussed in this paper.



**73. Studies in refrigerated preservation of perishable foods.**

P. B. MATHUR and H. C. SRINIVASTAVA, Mysore.

Refrigeration has come to be recognised as a very important means of food preservation. We have about 125 Commercial Cold Stores in India now. Data collected over a period of 6 years at the Central Food Technological Research Institute, Mysore, in connection with the refrigerated preservation of 47 commodities are described in this paper.

**74. Studies on spoilage caused by temperature variation in grain stored in bins.**S. V. PINGALE, M. V. SHIRANGAPANI, S. K. MAJUMDER and  
B. H. KRISHNA, Mysore.

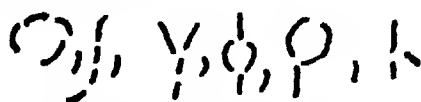
Changes effected by an average diurnal variation in temperature of 7°C on grain containing 12 and 16% moisture and insects and no insects when stored in metal, cement concrete, earthen and laked-tile bins are described. Different thermal conductivities and sorptive powers of bin walls used in the experiments have reflected on the accumulation and dissipation of heat, setting up of moisture gradients that are either favourable or antagonistic to the growth of micro flora, CO<sub>2</sub> and O<sub>2</sub> tension and consequent biological activities. In steel and concrete bins anaerobiosis set in as a result of insect or microbial activity restricted the damage by these two agencies but spoilage as a function of sharp rise and setting up of gradient in moisture level continued and relatively more damage has therefore occurred. Earthen and tile bins having sorptive powers and lower thermal conductivity on the other hand accumulated heat, caused egress of moisture and thus protected the grain from deteriorative changes. Reflective surface and an insulatory material between the grain and the bin wall reduced damage in the steel and concrete bins. A need for effective insulation when these bins are used is therefore stressed.

**75. Cytological investigations of autotetraploids of jute (*Corchorus olitorius* Linn. var. C.G.).**

G. I. PATEL, Nilganj and R. M. DATTA, Calcutta.

The autotetraploids are vigorous and produce more branches giving a bushy appearance to the plant. They are on an average shorter in height and flower for a longer duration than the normal diploids. The pod-setting is poor. Good seeds that were gathered are larger than the diploids but varied in size. The germination of the seeds recorded was about 90.0% as good as normal diploids. The resulting population of the autotetraploids varied to a certain extent in their growth and morphological characters.

A great variation in the meiotic pairing was noticed. Hexavalents, pentavalents and trivalents were occasionally found besides the commonly occurring quadrivalents, bivalents and univalents. In few cases perfectly normal (14 II) pairing was seen. Maximum number of quadrivalents noticed were four. Six types of quadrivalent configurations were



—arranged according to the frequency of their occurrence. Amongst 1252 quadrivalents recorded, the most frequent types were those with symmetrical arrange-

ments, that is : the single ring (61.8%) and simple chain (29.4%). Rest of quadrivalent configurations were of the remaining last four types. The maximum occurrence of the ring type of four chiasmata is very common.

At M. I., 67.1% of the pncs had univalents in them. Maximum number of univalents noticed were six. Pncs with two univalents were very common. Lagging chromosomes were seen in 55% of the pncs at anaphase and telophase I. As many as six laggards were noticed. Chromosome elimination and micro-nuclei formation were also seen at telophase I. Unequal distribution of the members of quadrivalents occurred frequently resulting in the production of aneuploid daughter nuclei at telophase I and hence the aneuploid gametes. At anaphase I, the number of chromosomes in both the groups were determined in 40 sporocytes. There was 14-14 distribution in twenty-one (52.5%), 13-15 in sixteen (40.0%) and 12-16 in three (7.1%) of them.

Percentage of grains got stained in acetocarmine and their size varied much in different 4n plants. Percentage of pollen germination in 4n C.G. was recorded to be 8.1%, while in that of 2n, it was 85.0%.

The pollen and ovule fertility of autotetraploids is quite good : Triploid population was raised by crossing 4n with 2n.

Several crosses between autotetraploids of *C. olitorius* (var. C. G.) and those of *C. Capsularis* (var. D 154) were made. The pod setting was very poor. A few normal looking full seeds obtained were defective in the development of seed tissue. The seeds did not germinate. More crosses are still being undertaken.

#### 76. Colchicoidy in the wild types of *Corchorus olitorius* Linn. and *C. capsularis* Linn.

G. I. PATIL, Nilgauj and R. M. DATTA, Calcutta.

Autotetraploids were successfully produced in the wild types of both the cultivated species of jute—*C. olitorius* and *C. capsularis*.

The effect of 0.25% aqueous solution of colchicine was more drastic in both seed as well as seedling treatments. It had been observed that this drastic effect for the same concentration and duration of treatment was more on the wild types of *C. olitorius* than on *C. capsularis*. The treatment of seedlings for 24 to 48 hours was found quite effective. The seedling treatment by the hanging drop method, though more laborious, gave better results than the seed treatments mainly due to the fact that the radicle was not affected and hence more number of affected seedlings survived and got a better start.

The autotetraploids of both are vigorous, producing much more total growth and the leaves, stomata and floral parts are much larger than the corresponding diploids. At the stage of the very rapid growth of the plants, the young immature leaves were found drying out from margin inwards increasing and spreading this with the expansion of the leaves. The duration of flowering in these tetraploids is distinctly much longer than in the diploids.

Fourteen bivalents to seven quadrivalents and all the in between combinations of quadrivalents, bivalents and univalents were observed at diakinesis. At Metaphase I, the presence of 2 and 3 univalents was frequent. Maximum number of them observed was seven. As many as six laggards were noted at anaphase I. Distribution of chromosomes in both the meiotic divisions was found quite irregular. Monads to octads with and without micro-nuclei were recorded.

In the 2nd wild types of both the species, above 90% of the grains were stained (potentially viable) and the variation in the pollen size was small. The range in the percentage of stained grains and pollen size varied very considerably in the different 4n plants but particularly more so in that of *C. olitorius*. Percentage of pollen germination in 2n is more than in 4n.

Autotetraploids of both the wild types were crossed in either directions. few full seeds were obtained but failed to germinate.

#### 77. Changes in Tomato Juice on Storage.

S. P. ROY CHOWDHURY and B. P. GYANI, Patna.

Tomato juice has been examined after storage under different conditions (exposure to atmosphere before and after crushing storage under brine; storage at low humidity and storage at low temperatures). Refrigeration appeared to be only practical method of short range preservation. The unbroken fruit hardly showed any changes for about a month, but the crushed fruit showed a mould after about a fortnight (10°C). The whole fruit was spoiled on long storage (4 months) when at 0°C. The juice stored in brine showed putrefaction at room temperature (30-32°C) in 18 days. In all other crushed samples putrefaction started in a day or two. The pH changes were followed in most cases and the amount of free acid formed was determined in some cases. Average pH of the fresh fruit was found to be 3.5, and 100 g. fresh juice required 1.96 ml. N/1 NaOH for titration. Invert sugar was 0.22 g. and reducing sugar 3.9 g. per 100 g. juice.

Supplementary work with potatoes and tamarind extracts shows that long range preservation of sliced tomatoes may be possible under dry storage.

#### 78. Inheritance of stigma colour and leaf shape character in *Hibiscus cannabinus* L.

P. SANYAL and A. N. DATTA, Barrackpore.

The investigations reported here deal with the genetics of stigma colour and leaf shape in *H. cannabinus*. Two strains were employed in these investigations and the characteristics for which they were used are given below:—

Strain	Studied for
M.T. 15 ...	White stigma, entire leaf.
M.T. 129 ...	Red stigma, divided leaf.

#### INHERITANCE OF STIGMA COLOUR

In *H. cannabinus* the stigma colour is usually red. But the authors while studying the different patterns of anthocyanin pigmentation in this species came across a type which had white stigma which was hitherto unknown. The material was isolated from M.T. 15, a type obtained from Vizagapatam, South India. During 1953, however, in a seed plot of this material two mutant plants having white stigma were recorded for the first time. The progenies of these two mutants bred true to the parents.

Relationship of red stigma colour with white stigma.

The  $F_1$ s had red stigma. It is, therefore, a case of complete dominance of red stigma over white stigma. Five  $F_2$  families were grown and studied. The  $F_2$  progenies segregated into red and white phenotypes in the expected ratio of 3:1. Back-crosses with red parent gave progenies that were all red while back crosses with the white parent segregated into red and white stigma in the ratio of 1:1.

The data show a monogenic difference between red stigma and white stigma controlled by a single factor pair which may be designed as R—r (R—Red, r—white).

## INHERITANCE OF LEAF SHAPE CHARACTER

Besides the colour of the stigma the two types differ from each other in the shape of leaf, M.T. 129 having divided leaves and M.T. 15 having entire leaves as described by Howard and Howard (1911).

Relationship of the divided leaf character with the entire leaf type.

The  $F_2$ s had divided (lobed) leaf. It is, therefore, a case of full dominance of divided type over entire type. The  $F_2$  progenies segregated into divided and entire phenotypes in the expected ratio of 3:1. Back-crosses with the divided parent gave progenies that were all divided while back-crosses with entire parent segregated into divided and entire phenotypes in the ratio of 1:1.

The data show a monogenic difference between divided and entire leaf characters controlled by a single factor pair which may be designated as D—d. (D—divided, d—entire).

## STIGMA COLOUR AND LEAF SHAPE

The classification of the  $F_2$  plants and back-crosses on the basis of joint segregation of stigma colour and leaf shape character was also made. In  $F_2$ , a dihybrid ratio of 9:3:3:1 was observed and therefore, there was no evidence of any linkage between D—d, the divided leaf factor pair and R—r, the alleles controlling the stigma colour in *H. cannabinus* L.

## 79. Status of Paddy Blast in Hyderabad State.

SYED VAHEEDUDDIN, D. BAP REDDY and S. V. PANDIT,

Hyderabad-Dn.

Paddy blast, *Piricularia oryzae* is a very serious disease of rice in the State. It has been introduced into the State about 10 years ago, most probably from Madras. It was first noticed at Sewage Farm, Anberpet and later on it made its appearance in many far and widely situated localities. An extensive survey for the presence and prevalence of blast was conducted during 1954-1955. The data collected revealed that among the eight rice growing districts of the State, blast is present in all of them excepting Nalgonda. Information collected suggests that the spread of the disease has been along with the spread of the improved strains of Paddy. Wherever nitrogenous fertilizers are given in large quantities the intensity increased. Blast has been found more common during Abi (June-October) than in Tabi (November-April). Prevalence of the disease was more on HR. 19, 35 and 47. Prevention of movement of seed from the infected fields to other places, treatment of seed before sowing with Agrosan at the rate of 6 ozs. per 112 lbs. of seed; spraying with 3-3-50 bordeaux mixture in the nursery stage and another spraying with 5-5-50 Bordeaux mixture one month after transplanting have helped in checking the further spread of disease to new places and minimising the occurrence and seriousness of the Blast.

## 80. A study of wild rices.

S. SAMPATH, Cuttack.

Species and varieties of so called wild rices were grown and intercrossed. These wild rices belong to four species *Oryza perennis*, *O. sativa* var. *Spontanea*, *O. breviligulata* and *O. australiensis*. *Oryza perennis* studied included four geographical varieties and one of them *O. perennis* var. *Barthii* failed to crossfertilise the other varieties or species and similarly *O. australiensis*. *O. perennis* var. *Balunga* of Orissa crosses freely with the cultivated rices *O. sativa* and *O. glaberrima*. *O. perennis* could be the species from which the cultivated rices were evolved. *O. breviligulata*

resembles some of the *O. sativa* var *Spontanea* of India, but gives completely sterile hybrids with *O. sativa*. *O. sativa* var *Spontanea* shows variability in morphological characters and this variability could be due to natural crossing between wild and cultivated rices. All the species and varieties studied had  $2N=24$  chromosomes. The meiosis in the hybrids studied was normal.

#### 81. Canning of Litchi.

U. P. VERMA and S. AHMAD, Sabour.

Out of Deshi, Bedana, Kasba, Purbi, etc., Purbi variety is better canner. It retains original flavour colour, texture and quality of the fresh fruits in the can.

The use of tartaric acid in the concentration of 0.4% has been found to be effective in checking browning of the flesh and in reducing the pH of the Covering syrup sufficiently without making it too sour, whereas citric acid has been found to react with the tin coating, according to the degree of concentration in the covering syrup.

The fruit pieces when blanched prior to filling in cans does not materially help in checking subsequent browning of the flesh, rather it makes the pieces too soft.

The sterilisation of litchi canned in 1 lb. Butter size cans can be very safely conducted at 212°F for 20 minutes.

### SOIL SCIENCE

#### 82. Some physico-chemical characteristics of alkali soils of Surat District in Bombay.

B. C. DEB and S. P. CHADHA, Poona.

There are eight patches of kharland soils bordering Kakrapar command area in Surat District. Detailed physico-chemical properties of typical samples from these areas have been studied. The results show :

- (i) Appreciable amount of soluble salts is present in the soils.
- (ii) pH of the soils is generally near 8.5, but pII increases considerably on washing out the soluble salts.
- (iii) Soils are generally clayey. Sandy soils are very few. Loamy soils are also not present to any appreciable extent.
- (iv) Calcium carbonate is present in the soil and in considerable area, the amount present even in surface soils is appreciable.
- (v) Average base exchange capacity of soils is of the order of 32 m.e. per 100 gms.
- (vi) Appreciable amount of available potassium is present in the soil.
- (vii) 32% of the soils tested have sodium saturation less than 15% and the rest of the samples have higher degree of sodium saturation; showing that soils are saline-alkali soils.

It is, therefore, suggested that for reclamation of these khar land soils, following steps should be taken :

- (a) For washing out soluble salts, drains at frequent intervals should be provided.
- (b) For soils having sodium saturation more than 15%, exchangeable sodium will also have to be removed. This can be done in case of soils having  $\text{CaCO}_3$  by applying organic manure or green manuring. In case of soils where  $\text{CaCO}_3$  is not present in sufficient amount, some gypsum has to be added.

**83. Studies on the Cathode layer enrichment in the analysis of Micro-elements in Soils.**

**C. DAKSHINAMURTI and S. C. MEHTA.**

Intensity of light emitted by the microelements introduced into a D.C. carbon arc is known to be rich in the cathode layer zone. The cathode layer enrichment is a function of the arc temperature which depends on the nature of the arcing material. With a view to understand the extent to which cathode layer arc effect is operative with different arcing materials, spec-pure carbon powder, synthetic soil base and its individual constituents namely aluminium oxide, salica, potassium sulphate, magnesium oxide, ironoxide and mixture of equal parts of sodium, potassium and calcium carbonates were used as arcing materials. The results obtained are discussed in relation to the ionization potentials of the elements and volatility of the compounds introduced into the arc column.

**84. A preliminary note on the influence of minor elements and Jute cropping on certain soil characteristics and on incidence of diseases.**

**M. K. MUKHERJEE, S. C. CHAKRAVORTY, A. B. ROY and A. K. BANERJEE,**  
Barrackpore.

It has been found that in plots treated with B, Zn, Cu, Mn, Mo, Co there was a slight increase in the number of diseased plants in all the plots except where copper was added. It also gives an indication that the quantity of these elements play an important role. In most of the cases the incidence of disease was more where lower doses of the particular element was applied. Though fibre yield recorded a slight fall in many cases the seed yield increased.

It may be of interest to note that Boron in general has helped in nitrate formation in the imbibitional water and no ammonia is found whilst a very little nitrite is formed, whereas in case of cobalt less nitrite is found. In case of copper and zinc, nitrite formation is more but in case of vanadium and cobalt, nitrate formation is comparatively less. In all these cases except borax 7.5 lbs/acre it has been found that P has fallen.

The changes in ammoniacal, nitrite, nitrate-nitrogen and phosphorus as also amino acids in the imbibitional water is greatly influenced by the nature and number of soil microorganisms. It may therefore be concluded that soil microorganisms has been influenced differently by these substances.

**85. Effect of growing Jute in the amelioration of red soils.**

**M. K. MUKHERJEE, S. C. CHAKRAVORTY and S. GHOSH,** Barrackpore.

Red soils of India occupy a large area. They are very poor in their available phosphate. In these red soil areas, several multipurpose projects are being sponsored.

It has been found that after jute, the soil available phosphorus status has improved and organic matter has also increased. It may be mentioned that in all these cases in all the replicates, the yield of paddy and straw were considerably higher where jute was grown with or without ammonium sulphate than those plots where no jute was grown, showing thereby that soils were in a better state of fertility if jute be grown as a preceding crop. Jute can be grown in the Mayurakshi, Damodar and Hirakud areas with irrigation and it is felt that if jute be grown in these areas, the soil will become enriched in available phosphate and it will be more so if all the leaves be shed in the fields and thinned out plants

and twigs are returned to the fields and retting water, silt and mud from retting tanks be added to the soils.

It may further be mentioned that jute may possibly be used as a green manure crop in total-phosphate rich tract in available phosphate poor red soils for improvement of available phosphate status.

#### 86. Alkalinity problem in soils irrigated by sullage water.

R. S. MURTHY AND S. P. RAYCHAUDHURI, New Delhi.

For agricultural purposes, alkali soils are regarded as a class of problem soils that require special remedial measures and management practices. The distribution of saline and alkaline soils is extensive throughout India in all climatic zones. They have resulted for more than one reason viz., (i) by the introduction of canal irrigation to the arid and semi-arid regions which has thus brought about a considerable rise in the level of subsoil water table, (ii) seepage from canals, (iii) bad aeration and drainage and (iv) the entry of sea-water by creeks leading to water logged conditions. Morphological and chemical studies of soils collected from the military farm at Ambala (Punjab) reveal that the development of alkalinity is due to the continuous irrigation of soils by sullage water for over 25 years.

Top soils are generally heavy and clayey in texture, clay content ranging between 34 and 50 per cent. Clay content decreases with depth in the second and third layers, making the subsoil lighter. Accumulation of clay in the last layer is prominent.

Soils are strongly alkaline, pH readings ranging between 8.5 and 9.5. Conductivity of 1:2 soil water extract of top soils is 1 to 1.3 m.mhos/cm. Soils are highly dispersed and the dissolved organic matter present in the soil solution gets redeposited on the soil surface by evaporation. This is shown by the organic carbon content being comparatively high in top layers, 0.72 to 0.88 per cent. The exchangeable sodium content is also high, 1.3 to 1.8 m.e./100 gm. soil. The soil solution although relatively low in soluble salts, the anions present consist mostly of chloride, 30 to 35 mgm/100 gm. soil and bicarbonates, 130 to 150 mgm/100 gm. soil. Carbonates are present in small amounts.

Reclamation of such soils can be brought about by the application of sulphur,  $\frac{1}{2}$  ton per acre and gypsum, 2 to 4 tons per acre and keeping the land fallow for sometime during the year. It is also necessary to dilute the effluent with water to reduce the harmful effects.

#### 87. Studies on saline and alkaline soils.

S. P. RAYCHAUDHURI and D. V. BHALKAR, New Delhi.

The importance of examining and establishing the theories of soil genesis cannot be over emphasised. Vilenskii's (1951) work offers an interesting piece of investigation as regards the saline and alkaline soils.

In the Indogangetic plains of India, saline and alkaline soils occur very widely distributed. These soils are alluvial in origin and do not have great variations in topography. Six saline and alkaline soil profiles from the states of Bihar, Uttar Pradesh, Punjab and Delhi State have been studied for ascertaining the physico-chemical characteristics so as to classify them in the various classes according to units given by U. S. Salinity Laboratory. These classes have been arranged in the sequence of their development in the above genetic theory of their formation and then examined to see as to how far they vary from Vilenskii's theory.

According to these units, soils from Madapurchhapra village (Bihar) have been classified as saline; those from Pusa (Bihar), Delhi State and Uttar Pradesh as saline-alkaline and soils from Karnal (Punjab) as alkaline.

Although saline soils lie in the humid region, the expected effect of leaching due to higher rainfall and humidity has not taken place. On the contrary, the alkaline soils show the effect of leaching despite low rainfall and semiarid climate. In these two extreme cases considering the external factors, rainfall and humidity have failed to give any relationship in their development. But when internal characters as nature of clay, accumulation of calcium carbonate, distribution of soluble salts and sodium saturation percentage are taken into consideration, Gedroiz's theory finds support.

#### 88. Soil conservation survey in the catchments of the tributaries of Teesta River— Part I: Survey in the catchment of Lish River.

K. SEN GUPTA and T. SEN GUPTA, Jalpaiguri.

Much of the flood problems of the Teesta river system is due to the tributaries of Teesta which have their catchment areas in the district of Darjeeling namely, Lish, Gheesh, Chel, Naora and Relli. It is necessary to take up a detailed soil conservation survey in the catchments of these rivers in order to draw up a comprehensive programme for soil conservation and flood control. Accordingly, surveys in the catchments of these rivers are being taken up one after another. In the first instance, survey of the catchment of the Lish river was taken up.

The Lish river originates in the Kalimpong subdivision and runs for 12 miles before it joins the Teesta river. The catchment of this river is highly erosive as will be evident from the rate of siltation which is about 1.5 ft. per year. During the survey, soil type, depth of soil and slope were determined and were delineated on a base map of 16"=1 mile. On the basis of these physical factors, the land capability map was prepared in the scale"=1 mile. It was observed that out of 7,600 acres under cultivation in the catchment area, there are no class I lands. Only 180 acres belong to class II, 250 acres are in class III, 101 acres in class IV, 165 acres in class V and the rest in class VI.

#### 89. Properties of Ganges Silt.

R. K. SEN and B. CHATTERJEE, Palta and Sibpur.

In continuation of our work on the seasonal variations in the properties of Ganges silt, studies have been made of the variations in pH and viscosity on the gradual addition of alkali to hydrogen clays prepared from premonsoon and monsoon silts collected at Palta (Barrackpore, Calcutta), during 1952, 1953 and 1954. The pH-alkali concentration curves of H-clays prepared from pre-monsoon silt show two inflexion points, the ratio of the total acidity at the second inflexion point to that at the first being about 2.0. The viscosity-alkali concentration curves of these H-clays show a progressive fall. The potentiometric titration curves of the H-clays prepared from the monsoon silt show only one inflexion point. The viscosity-alkali concentration curves of these H-clays show a more or less flat portion, then a rise and finally a sharp fall after showing a maximum. These results in conjunction the data on chemical composition of these H-clays, suggest the predominance of Kaolinite in the pre-monsoon silt and the relative abundance of montmorillonite and/or illite in the monsoon silt.



**90. Brown Forest soils of Cochin.**

K. V. S. SATYANARAYANA and H. M. BASAVANNA, New Delhi.

In Cochin State, in the high rainfall low hilly areas east of the Western Ghats is a belt of tract prized for the high quality lemon grass it produces. The soils are different from the neighbour laterite tracts. The morphological, physical, chemical and mineralogical characteristics of a soil profile from Odakali, Lemon Grass Research Station have been studied. Morphologically the profile showed a dark brown A horizon followed by reddish brown B horizon with weathered rock at about 4 ft. depth. The pH of the soil is uniformly low (5.0) and the chemical analysis showed an accumulation of silica in the surface horizon and sesquioxides in the B horizon. The cation exchange capacity of clay is 40 m.e. and silica-sesquioxide and silica-alumina ratios are between 1 and 2.0. The fine sands contained high percentage of mica, some pyroxene and chlorite. The soil profile is developed on acid type rock. The disguised podsollic nature of the soil fits in best with the transitional sub-type of zonal soils, brown forest soil. This is the first recording of such a group of soil in this country.

## SECTION OF PHYSIOLOGY

*President* :—DR. IDERJIT SINGH, Ph.D., L.R.C.I., M.R.C.S.,  
M.B.B.S., F.N.I.

### *Abstracts*

#### **1. Effect of acute Haemolytic Anaemia on the estrus cycle of rats and its mode of interference in this endocrinal disturbance.**

SIRSI, M. and (Miss) M. INDIRA, Bangalore.

Acute haemolytic anaemia produced by phenyl hydrazine induces a state of anestrus in rats which persists till haemoglobin regeneration reaches almost the original value.

No variation in the cellular reaction of the vaginal epithelium to estrogen hormone during this anaemic phase is noticed.

The anestrus is due to the diminished follicular hormone production, partly as a result of direct effect on the ovary as exhibited by the delayed response of the follicular cells to serum gonadotropin.

The hypofunction of the pituitary with diminished gonadotrophic hormone production as evidenced by the weight loss, histopathological studies of the ovary and the reactions to serum gonadotropin is probably the primary factor in the causation of anestrus during anaemia. Whether anoxaemia and diminished oxygen supply is a sufficient explanation or other nutritional factors are involved needs further elucidation.

#### **2. Further evidence of the enhancement of Androgenic action of Testosterone Propionate by Progesterone.**

AMIYA B. KAR and N. N. DE, Lucknow.

The positive correlation between androgenic activity and the concentration of alkaline phosphatase in male accessory genital organs, has been utilized in the present study to demonstrate the additive effect of progesterone on androgenicity of testosterone propionate. It has been shown that castration causes disappearance of alkaline phosphatase activity from the seminal vesicles of the rat. Administration of progesterone to castrates only slightly stimulates phosphatase activity in the seminal vesicles but testosterone propionate causes a strong mobilization of the enzyme in this tissue. Combined therapy with progesterone and testosterone propionate is associated with a greater stimulation of phosphatase activity than is noticed after treatment with either of the hormones alone. This shows a summation of androgenic properties of the two hormones and provides confirmatory evidence of the previous findings made by the authors (*Endokrinol.*, 30, 222, 1953).

#### **3. Normal Sodium level in human blood.**

S. P. ROY CHOWDHURY and B. P. GYANI, Patna.

Blood plasma drawn from 26 males and 9 females in the age group 16-42 years have been examined for sodium content. Eleven of the males belonged to the staff of the Patna General Hospital and the Public Health Institute, Patna; the rest were

attendants all in normal health. The females were also in normal health. The maximum and minimum sodium contents were 327 and 270 mg. per 100 ml. of plasma respectively for the males and 329 and 277 for the females. The average for males was 304 with S.D.  $\pm 10$  and for females 307 with S.D.  $\pm 16$  mg. per 100 ml. plasma. The upper income group (males) showed a variation between 314 and 297.

On statistical analysis, the difference between sodium levels of males and females in normal health is insignificant when degree of freedom is 32 and "t" value is 0.68.

#### 4. Alkali Resistant Haemoglobin in Animal Blood.

S. K. GHOSH, J. B. CHATTERJEE and D. K. BANERJEE, Calcutta.

Alkali resistant haemoglobin in the red cells of several adult animals and birds was estimated by the alkali denaturation technique of Singer *et al* (Blood, 6 : 413, 1951). Blood of adult monkey, cat, chicken, rabbit, sheep, goat and cow showed a mean value of 5.72, 6.06, 59.6, 69.9, 69.9, 77.7 and 78.0 g. % of alkali resistant haemoglobin respectively. The mean value for adult human blood was 1.2% and that for cord blood was 59.2%. The reason for high content of alkali resistant haemoglobin in the blood of some of the animals is not clear.

#### 5. Chromatographic separation of Sodium and Potassium in biological fluids.

S. B. CHOWDHURY, D. P. SADHU and P. C. ROY, Calcutta.

Estimation of Sodium and Potassium in Biological fluids is very important in many Physiological and Pathological conditions. A Chromatographic separation and estimation of Sodium and Potassium in blood and urine is described. The method depends on the removal of different interfering substances from these Biological Fluids and then subjecting the final chloride mixture to Chromatographic separation with Ethyl Alcohol : Water (94 : 6) as mobile phase. The Chromatogram is treated with 0.1N Silver Nitrate and the coloured band is treated with Nitric acid. The Silver Nitrate solution thus produced is treated with 0.1N KCNS. The method is quite suitable for laboratories where dust accumulation cannot be completely prevented.

#### 6. Preliminary investigation on Green Margosa (Bengali Neem) leaf extracts.

D. ROY CHOWDHURY, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

In the present investigation, effect of Margosa leaf extracts on heart, intestine and uterus has been observed. It has been seen that both water and alcohol extracts have pronounced effect on heart and intestine. Water extract has been found to have a stimulating effect on the perfused toad's heart. It does not, however, increase the frequency of heart beat but the force of contraction thereof is considerably increased. Effect of the alcohol extract is not stimulating. In all dilutions, it decreases the force of contraction and the rate too, and is sometimes slowed. 0.5 c.c. of the crude water extract inhibits the heart completely in a contracted condition while the alcohol extract in the same dose stops the heart in relaxation. So far as the effect of the extracts on intestine is concerned both of them have been found to inhibit, to a marked degree, the tone of the intestinal musculature.

**7. Determination of neutral 17-Ketosteroids in urine.**

SATINATH SEN, S. B. CHOUDHURY and D. P. SADHU, Calcutta.

A modified method for the estimation of neutral 17-Ketosteroids in rat's urine is described. The method depends upon the hydrolysis of urine by 1 c.c. of 10% Copper Sulphate solution and 1 c.c. of concentrated Hydrochloric acid and subsequently extracting the liberated Ketosteroids by Chloroform. The evaporated Chloroform extract is treated with Porter-Silber reagent, and the developed colour is measured in Unicam Spectrophotometer at a wave length of 410 m $\mu$ . The average amount of neutral 17-Ketosteroids excreted per day per rat is found to be  $310\gamma \pm 10$ .

**8. The effect of Oestradiol Monobenzoate on the Oxidative Enzymes of Rat Testis.**

B. CHAUDHURI, A. K. CHOWDHURY and D. P. SADHU, Calcutta.

The effect of oestradiol monobenzoate has been studied on the oxidative enzymes of Rat Testis. Forty male albino rats weighing from 109 to 135 gms. were used. Ten rats served as the control, while others were subjected to daily intermuscular injection of 300  $\mu$  gms. of oestradiol monobenzoate in oil suspension. Six rats from treated group were sacrificed at intervals of twelfth, thirteenth, fifteenth, eighteenth and twenty-fourth days of injection. The animals were decapitated and testis were removed immediately and dried on filter paper. Decapsulated testis was weighed and homogenised at 0°C with phosphate buffer at pH 7.4. Tissue suspension was made such that 2.3 ml. of the suspension when added to 0.5 ml. of the substrate, final concentration of the enzyme preparation in the reaction vessel would be 10 per cent. This was incubated at 38°C. Sodium succinate (0.5 M) and sodium ascorbate (0.114 M) were used as substrates for the determination of succinic dehydrogenase and the cytochrome oxidase respectively. The enzymatic activities were studied by the determination of oxygen consumption in Warburg's Apparatus. There is an inhibitory effect of enzymatic activity in the earlier phase of oestrogen treatment, which is followed by an increased activity of the succinoxidase system after prolong injection of oestradiol monobenzoate.

**9. Differential rate of survival of the spawn of Indian economic fish as a function of water treatments.**

B. C. DAS, Calcutta.

There is a great economic waste at present of one of India's natural resources, fish spawn, which probably runs into crores of rupees a year. Systematic scientific study may provide a guide whereby spawn culture in the future may add high quality protein to the national diet at low cost. A series of experiments were conducted in the laboratory on the spawn of Indian carp (*Labeo-Rohita* and *Catla*) to determine the rate of survival as a function of age and the differential effects of several experimental treatments. The experimental design utilized three groups, each of which consisted of five replications. The first group was a control group; the second used antibiotic treatment of water; and the third group received a vitamin B complex. The results indicate that rate of survival is lowest during the period between the third and twelfth days of spawn life, and that the experimental treatment increased the rate of survival during this period, and hence the total number of spawn surviving. Practical implications of these results lie in the short period of treatment required to increase the total number of spawn surviving.

**BACTERIOLOGY****10. Bacteriological study of Market Milk (Raw) of Darjeeling.**

SATYA RANJAN SARKAR, Darjeeling.

The bacteriological tests (standard plate count, coliform test, keeping quality, dye reduction—methylene blue, and acidity) had been undertaken on the market milk (raw) of Darjeeling. In Darjeeling milk is supplied by small vendors from nearby places of 2 miles and also by dairies, majority of whom collect the milk from vendors residing 3 to 8 miles away.

Samples of the above had been collected through five different houses per day for a week. Of these, 3 (marked A, B, C) were supplied by dairies and the other 2 (D, E) were supplied by small vendors. The experiments were conducted in August, 1956 on average temperature (maximum—67·7, minimum—61·4) and average humidity 90·1.

A, B and C samples respectively showed average bacterial counts 80,00,000, 34,80,000 and 11,90,000; acidity 0·118%, 0·149%, and 0·155%; keeping quality 4 hours, 7½ hours and 15 hours; dye reduction time 1, 1¼ and 4¼ hours; coliform positive in 1/1000 and 1/100 dilutions.

D and E Samples respectively showed average bacterial counts 32,00,000, 17,70,000; acidity 0·149% and 0·146%; keeping quality 10¼ and 13¼ hours; dye reduction time 1¼ and 2½ hours and coliform positive in 1/1000 and 1/100 dilutions.

Generally, milk supplied by the small vendors showed better bacterial quality than the same of the dairies. C. sample, though supplied by a dairy showed best bacterial quality as the milk was of its own cows and supplied in special containers. In general the keeping quality was found to be better in Darjeeling than in the plains. Some correlation was noted as the samples having high bacterial count showed lower acidity and shorter dye reduction time.

**11. The production of Leucocytosis in Albino rats using the Phosphomolybdic Acid-Tocopherol complex.**

P. P. NAIR and N. G. MAGAR, Bombay.

The phosphomolybdic acid-vitamin E complex was administered in small quantities parenterally to adult albino rats and the changes in peripheral blood picture was studied. A noticeable lymphocytosis occurred in 48 hours showing specific stimulation of lymphoid tissues of the animal system. The mean total W.B.C. values showed a rise of more than 3000/c.m.m. in 48 hours, which steadily rose to 4000/c.m.m. at 96 hours before it recorded a fall on the sixth day. This was considered to be significant as it is known that lymphocytes contain the essential constituent  $\gamma$  globulin which carries the immune bodies concerned in the protective defences of the organism. No significant changes were observed regarding Haemoglobin and total R.B.C.

**BIOCHEMISTRY****12. Occurrence of 1:2 Dienol Glucose in normal blood : Its reaction with Alloxan and Chromatographic identification.**

M. C. NATH and E. P. M. BHATTATHIRY, Nagpur.

1:2 dienol glucose liberated on acid hydrolysis from the condensation product of glucose and acetoacetate (2-tetra hydroxy butyl, 5-methyl, 4 Carbethoxy furan) as well as normal plasma after deproteinisation have been found to combine directly

with alloxan to give rise to alloxanic acid which is non-diabetogenic, thus indicating the presence of the diol glucose in normal blood.

The existence of this endiol glucose in blood has further been confirmed by taking recourse to the technique of Circular paper chromatography. Ammonium phospho-molybdate reagent which is specific only for endiol compound has been used for colour development of the chromatogram. The  $R_f$  value of this active glucose has been found to be 0.92. This has also been confirmed by T.T.C. as the colouring reagent, the  $R_f$  of ordinary glucose is only 0.32.

The other endiol compound in blood is the ascorbic acid, the  $R_f$  of which is 0.52.

### 13. Further studies on the prevention of Dehydroascorbic Acid Diabetes by the condensation product of Glucose and Acetoacetate—and its mechanism.

M. C. NATH and R. M. BRHKE, Nagpur.

The daily urinary excretion of dehydroascorbic acid, ascorbic acid and diketogulonic acid was studied in rats, given daily intravenous injections of dehydroascorbic acid, condensation product (Na salt) 2 minutes before dehydroascorbic acid, and hydrolysed condensation product before dehydroascorbic acid respectively for three successive days. The blood and tissue levels of the above three acids were determined along with the blood sugar. The effect of hydrolysed condensation product on the prevention of dehydroascorbic acid diabetes was studied. The *in vitro* incubation studies were made by incubating dehydroascorbic acid with Na salt of condensation product and hydrolysed condensation product respectively. The excretion of diketogulonic acid and ascorbic acid is less in animals protected from diabetes by the condensation product. Dehydroascorbic acid on the other hand was found to be excreted more by the protected animals. More diketogulonic acid and ascorbic acid and less dehydroascorbic acid, were found in blood and tissues of protected animals than in the diabetic ones. The hydrolysed condensation product when administered 2 minutes before the diabetogenic dose of dehydroascorbic acid was found to be much more effective to prevent the onset of diabetes. Dehydroascorbic acid when incubated with hydrolysed condensation product reduced the former to ascorbic acid while the Na salt of unhydrolysed condensation product did not show this effect. 1:2 endiol glucose liberated from the condensation product on hydrolysis has been shown to be responsible for the regeneration of ascorbic acid and thus to prevent the diabetogenic effect of dehydroascorbic acid.

### 14. Histopathological changes by Acetoacetate in normal and scorbutic guinea-pigs.

S. G. NAYUDU, SAILEN MOOKERJEE and M. C. NATH, Nagpur.

The histopathological changes induced by acetoacetate in the pancreas, liver and kidney of normal as well as scorbutic guinea pigs have been studied. The pancreas of the scorbutic guinea pigs as well as of those injected acetoacetate showed hypertrophy of the islets of Langerhans. When acetoacetate injections were superimposed on scurvy, further degranulation and more marked changes were observed. Acetoacetate brought about hypertrophy of the kidney cortex, whereas the changes in the scorbutic guinea pigs were indicative of the atrophy of the glomeruli. The degenerative changes were further aggravated when scorbutic guinea pigs were injected acetoacetate. The hepatic cells around the central vein, showed degenerative changes in the scorbutic guinea pigs and also in the animals injected acetoacetate. When the scorbutic animals were injected acetoacetate,

more marked degenerative changes such as haemorrhage of the hepatic cells round the central vein were observed. The biochemical findings as regards the aggravation of disturbances in scurvy by acetoacetate have been confirmed by the histopathological changes cited above, thus demonstrating the toxicity of acetoacetate on the structural integrity of the tissues. The possibility of acetoacetate acting as a prime factor for the clinical development of diabetes has further been envisaged.

#### 15. Glycolytic activity of Piscine hearts.

B. M. ROICHAUDHURI, P. C. KARMAKAR and A. K. DASGUPTA, Calcutta.

The rate of loss of cardiac glycogen of the four species of fish investigated, viz., Kai (*Anabus testudineus*), Lata (*Ophicephalus punctatus*), Magur (*Clarius batrachus*) and Singi (*Hetropneustic fossilis*), has been found to be in the decreasing order as follows :

Singi > Magur > Lata > Kai

It has also been observed that the anaerobically beating heart of Singi survives the best and that of Kai the least. This finding confirms the observation that the hearts having a higher resistance to asphyxia have a higher glycolytic activity than those having a lower resistance. It was also found that the percentage of glycolysis of the ventricular glycogen of magur and lata are higher than those of the auricular glycolysis. But in the other two species (singi and kai) the percentage of auricular glycolysis were found to be higher than those of ventricular glycolysis.

#### 16. Studies on the effect of Selenium on C.N.S. with the help of electroencephalograph.

N. N. DAS, R. N. ROY and S. R. MAITRA, Calcutta.

Control EEG record of rabbit showed the frequency of 55-60c/sec and the voltage 0.4-0.5 u.v. After 2 mg of selenium dioxide per kg the initial action was increased in frequency 60-65c/sec and voltage 0.6-0.7 n.v. After 5 minutes interval excitation was noted accompanied by increase in voltage and frequency. After 10 minutes no alteration of voltage or frequency was observed. Again 2 mg of selenium injection produced further irritation. After 5 minutes of the second injection the effect was almost the same. Later on the frequency and voltage were decreased. The overall picture of selenium dioxide is temporarily irritant followed by depressant effect.

#### 17. Effect of Phenylmethylaniline-p-aminobenzene Sulphonate (Sulfomin) on C.N.S. with the help of E.E.G.

R. N. ROY, N. N. DAS and S. R. MAITRA, Calcutta.

After the injection of the drug (10 mg) the voltage was increased from 0.3 u.v. to 0.5 u.v. and the frequency from 35/sec to 40/sec. After the interval of 5 minutes no alteration of result was observed. After second injection voltage was increased to 0.6 u.v. and frequency 60/sec. Later on another 5 mg injection caused slight irritation followed by depression. After 10 minutes showed slight depression. The drug at first stimulates the brain observed by increased voltage and frequency followed by depression determined by diminution of voltage and frequency. During the experiment the animals did not show any toxic symptom. So it may be concluded that it has no toxic manifestation on the C.N.S. because they have been observed for few days after the experiment.

**18. Correlation between bicarbonate of blood and acidity of the gastric juice.**

B. S. KAHALI and S. P. MONGIA, Jaipur.

Thirty subjects were studied. These consisted of cases of iso, hypo and hyperchlorhydria as determined clinically. The Biochemical investigations included gastric analysis and estimations of blood bicarbonates. The gastric analysis was done with alcohol test meal. The blood bicarbonates were estimated in terms of "CO<sub>2</sub> combining power of blood" by Van Slyke and Cullen's method. Blood bicarbonates were also estimated before and after alcohol and histamine test meals in some subjects.

The highest free acidity in the gastric juice in normal healthy persons (Isochlorhydria) without any gastric symptoms was found to be 55 ml. N/10 HCL. It was observed that in those persons who had an isochlorhydria range of acid secretion the blood bicarbonates were within normal limits. The hypochlorhydric subjects showed a decrease in blood bicarbonates. In hyperchlorhydria the bicarbonate level was definitely higher than normal. The analysis of the blood samples before and after the histamine as well as alcohol test meals revealed that the acid secretion provoked no significant alteration in the amount of blood bicarbonates.

It is suggested that the high level of blood bicarbonates may act as an intense normal stimulus or act by sensitizing the parietal cells to normal stimulus. The high acid secretion can be partially explained on the theory of Donan's membrane equilibrium.

It is concluded that there is a definite correlation of the amount of blood bicarbonate to the intensity of gastric acid secretion and a raised blood bicarbonate level seems to be an aetiological agent of some significance in the development or persistence of hyperchlorhydria.

**19. Femoral depressor reflex—its nature and biological significance in dogs.**

M. L. GUPTA, Jaipur.

It has been observed by Mathur and Tandon, and Gupta that faradic current applied at the site of main branching of femoral artery causes a significant fall in blood pressure.

The nature of these receptors have been further investigated. The role of these receptors, in the fall of blood pressure resulting from mechanical stimulation of these receptors, has not been conclusive as the fall of blood pressure, obtained by passive movements of hind limbs, was still present after cocainizing and resection of the artery at the site of branching. The perfusion experiments have shown the absence of baroreceptors but have suggested the presence of chemosensitive receptors stimulated by fall of pH and depressed by rise of pH. The hypotensive effect is better marked after warming these sites. The fall of blood pressure on faradic stimulation is greater when the initial blood pressure is raised.

It is suggested that during muscular activity, rise of blood pressure, rise of temperature and fall in pH may work together to stimulate these receptors causing lowering of vascular resistance—which may bridle the pressure mechanism of exercise.

**20. Jaw opening Cardio-salivo-respiratory reflex in Dogs during pyrexia.**

B. S. KAHALI and M. L. GUPTA, Jaipur.

It has been reported by Mathur and Chowdhury (1952) that above certain critical temperature in dogs, which is 41°C in the rectum, opening of the jaw leads to a further increase of respiration compared to the rate with the jaw closed.



The jaw opening reflex has been further investigated. The findings of Mathur *et al* have been confirmed. In addition an increase of parotid secretion collected by parotid duct cannulization have been found at the critical temperature. On opening the jaw the parotid secretion was 4 to 5 times increased above the level of the secretion with jaw closed. This has been recently reported by Kumar (1956) who measured the secretion by nipping the mouth with weighed blotting paper.

An acceleration of the heart and a rise of blood pressure has also been observed on opening the jaw along with the salivo-respiratory reflex.

In an attempt to find the afferent paths involved it has been observed that cocainizing the mouth and tongue mucous membrane had no effect on the reflex. But the reflex disappears on injecting novocaine into the trigeminal ganglia or into the mandibular nerve at the foramen ovale.

It appears that opening of jaw, at this critical temperature, stimulates the proprioceptors (stretch receptors) of the jaw closer muscles and give rise to this combined Cardio-salivo-respiratory reflex for better salivation and its subsequent evaporation for temperature regulation.

**21. The effect of Acetoacetate on the accumulation of Dehydroascorbic Acid in the tissue of normal scorbutic guinea pigs.**

M. C. NATH and M. RAZDAN, Nagpur.

Acetoacetate (Na salt) while injected intraperitoneally to scorbutic guinea pigs has been found to bring about further decrease in the ascorbic acid content of the different tissues e.g. kidney, liver and spleen. Such decrease has been found to be proportional to the amount of acetoacetate injected. Along with decrease in the ascorbic acid level there has been a marked increase in the dehydroascorbic acid content of the tissues. Dehydroascorbic acid is usually absent in the normal tissues.

**22. Hypothermia and Respiration of Tissues in Vitro.**

D. P. SADHU, Calcutta.

There are two different types of responses to hypothermia *in vivo*, one reaction being typified in the hibernating animals, whose respiration resembles the changes in the oxygen consumption of tissue slices subjected to hypothermia *in vitro*, while the second response occurs in most mammals by a hypermetabolism induced by cold on thyroid, adrenal and other glands. Hypothermia was induced in the rat liver slices and bull semen in egg-yolk-citrate medium with or without glycine and the oxygen consumption has been measured at different low temperatures. The  $Q_{10}$  values have been calculated and  $Q_{10}$  of the above processes determined. The  $Z_{10}$  values of bull semen have also been determined in media with or without glycine in several hypothermic states.

**23. Indian multipurpose food and its supplementary value to poor diets based on different cereals and millets.**

V. SUBRAHMANYAN, S. KUPPUSWAMY, G. RAMA RAO, M. NARAYANA RAO and M. SWAMINATHAN, Mysore.

The Supplementary value of Indian Multipurpose food at 12.5% level to poor vegetarian diets based on rice, wheat and jowar was studied by the rat growth method. At 12.5% level, Indian M.P.F has a definite and highly significant supplementary value to poor vegetarian diets based on rice, wheat and jowar, and in this

respect comparable to American M. P. F. The protein efficiency ratio of the proteins of Indian M. P. F. (1.40) at 10% level of intake is slightly less than that for the proteins of American M. P. F. (1.67) at 10% level of intake. No significant difference, however was observed between the protein efficiency ratio of (i) mixed protein of Indian M. P. F. and Poor rice diet and (ii) mixed proteins of American M. P. F. and Poor rice diet at 13% level of protein intake.

**24. Studies on the effect of different seasons on various seminal attributes and their relation to the preservation in vitro.**

R. K. SRIVASTAVA and A. ROY, Mathura.

The respective FULL and HALF life in days during (A) Winter (B) Spring (C) Summer (D) Rain and (E) Autumn in (1) Glycine egg yolk made by mixing equal volume of 4% glycine and egg yolk (GEY) (2) egg yolk citrate were for BULL during A, 21.5, 12.0 (1) and 10.4, 7.0, (2); B, 17.5, 12.2 (1) and 10.7, 6.1 (2); C, 12.7, 8.4 (1) and 8.1, 4.8 (2); D, 14.2, 9.5 (1) and 8.6, 4.0 (2); E, 18.0, 13.7 (1) and 8.6, 5.0 (2); for BUFFALO 15.5, 12.0 and 5.4, 3.3; 16.8, 12.5 and 5.1 3.0; 11.8, 6.7 and 5.2, 2.7; 12.0, 6.3 and 5.0, 3.0; 16.0, 8.6 and 4.9, 2.5 for RAM 16.9, 11.9 and 9.3, 5.0; 11.4, 7.1 and 8.5, 3.5; 10.8, 6.0 and 10.6, 3.0; 14.0, 5.2 and 5.8, 2.4; 20.5, 11.2 and 9.3, 4.0. The preservation has been found to be positively correlated with fructolysis. Amongst other seminal attributes studied in this series were (1) Initial motility, (2) Sperm count (3) Percentage of living sperms (4) Percentage of total abnormal sperms (5) Percentage of living abnormal sperms (6) Initial fructose content and (7) Percentage of Fructolysis in one hour.

**25. The efficiency of various dilutors on the preservation of Spermatozoal Motility.**

R. K. SRIVASTAVA and A. ROY, Mathura.

In view of the marked effect of different seasons on the preservation of semen *in vitro*, the efficiency of 3% GEY (1), 4% GEY (2), EYC (3), and 4% GEY containing 5 mg. fructose per ml. (4) to maintain spermatozoal life was studied during WINTER only. The respective FULL (F) and HALF (H) life in days in 1-4 were, for BULL, 20.1, 11.8 (1); 21.5, 12.0 (2); 10.4, 7.0 (3); 32.0, 23.5 (4). For Buffalo, 14.7, 8.8 (1), 15.5, 12.0 (2); 5.4, 3.3 (3); 24.0, 20.0 (4); For Ram, 15.1, 9.7 (1); 16.9, 11.9 (2); 9.3, 5.0 (3); 22.4, 18.7 (4). The F and H during SUMMER in whole homogenised MILK (1), 4% GEY (2) GLYCINE MILK (1:2) mixture (3) and EYC (4) were for BULL, 5.8, 3.4 (1); 14.4, 5.8 (2); 8.2, 6.0 (3); 8.0, 3.0 (4).

The F and H during WINTER in EYC (1) 4% GEY (2) and glycine-citrate (1:1) egg yolk (3) were for BULL, 11.5, 4.0 (1); 22.9, 15.9 (2); 20.1, 12.7 (3).

**26. Investigations on the medicinal properties of banana. Part I : The Chemical Composition and Nutritive Value of Banana.**

V. SUBRAHMANYAN, B. S. LULLA, M. NARAYANA RAO, D. S. JOHAR  
and M. SWAMINATHAN, Mysore.

Investigations were undertaken to study the medicinal properties of well ripened banana. A sample of dried banana powder (Poovan variety) has been chemically analysed, and found to contain sugars (69%), pectin (2.5%), protein (5%), crude fibre (1.5%), acidity (2.2%). About 9% of the dry matter could not be accounted for by chemical analysis. Inclusion of banana powder in synthetic or rice diets results in a lower absorption of nitrogen. This may be due to the larger amount of fibre

(as hemi-cellulose and cellulose) in the diet containing banana. Inclusion of banana powder in synthetic or rice diets resulted in an increase in the faecal bulk. In the case of feeding experiments carried with synthetic diet, the faeces of rats fed on the experimental diet containing banana was about thrice the amount of faeces of rats fed on the control diet. The significance of the results of animal experiments are discussed in the light of the earlier reports on therapeutic properties of banana in diarrhoeal conditions.

**27. Influence of season on the growth response of Albino rats to the poor rice diet.**

V. SUBRAHMANYAN, S. KUPPUSWAMY and M. SWAMINATHAN, Mysore.

Experiments designed to determine the growth promoting value of poor rice diet based on different varieties of rice did not reveal any consistent correlation between the protein content of the rice and the growth-promoting value of the poor rice diet. In one experiment, two local varieties of rice high in protein (7%) promoted significantly higher growth than two other varieties low in this nutrient (5-5.5%). However, on repeating the experiment in another season, this difference in growth-promoting value was not sustained. This suggested the possibility of some relationship between the growth-promoting value of poor rice diet and seasonal variation in climate. Generally speaking it was found that for the same varieties of rice, higher rates of growth were observed in experiments started during the months of September to December than in those started during the other months of the year. Further, differences in the growth-promoting value of poor rice diets based on two or more varieties of rice were more pronounced during certain seasons of the year than during others. Preliminary investigations showed that an elevated environmental temperature exerts a significant depressing effect on the growth of animals raised on poor rice diet. The significance of the above and possible relation to human response will be discussed.

**28. Some observations on the effect of Asafoetida Oil on the intestinal microflora of rats.**

V. SREENIVASAMURTHY and L. V. L. SASTRY, Mysore.

Intestinal microorganisms have been known to cause certain internal disorders and it is an age old practice to treat such cases with diets containing asafoetida. How asafoetida acts and whether it has any effect on the intestinal flora is not known. Bhat and coworkers (J. Sci. Ind. Res., 13B, 765, 1954) after an *in vitro* study with the common intestinal organisms came to the conclusion that asafoetida does not possess bacteriostatic properties; however, they observed it increases  $H_2/CO_2$  ratio in the gas produced by the coliforms. Since the conditions existing in the intestines are different from what can be reproduced *in vitro* it was of interest to study the effect of asafoetida on the intestinal microflora in rats fed this condiment for long periods.

Adult albino rats fed with synthetic adequate diet were divided into two groups. One group was given orally ether-soluble fraction of asafoetida (0.02 ml of 1% asafoetida oil in groundnut oil) and the other group received only the vegetable oil. After 8 weeks of feeding, the rats were anaesthetised and the ceca were removed aseptically. The cecal contents were forced out and therein the counts of different types of microflora were made with the help of differential media. The results showed that coliform count in the asafoetida fed group was considerably less than that of the control group. Anaerobes also were similarly affected. The count of the acid forming type was, however, higher in the asafoetida fed animals than in the control animals.

These preliminary observations, which are being further pursued also in regard to thiamine sparing action throw for the first time some light on the role of asafoetida as a food adjunct similar to antibiotics. This study is being extended to other spices as well, with a view to establishing the effects, if any, of these in human nutrition at the levels they are used in foods. At the moment they are thought of as just flavouring agents or in therapeutic doses as carminatives.

#### 29. Growth inhibition of micro-organisms by Coffee.

D. S. JOHAR, C. P. NATARANJAN and T. N. RAMACHANDRA RAO, Mysore.

The effect of different concentrations of coffee extract on inhibiting the growth of bacteria, yeast and mould have been studied. The results indicate that coffee decoction inhibits the growth of certain type of bacteria but has no effect on moulds and yeasts. Further studies are in progress on the effect of coffee vapours on the growth inhibition of microorganisms. Preliminary trials on the active principles in coffee responsible for this inhibition are under progress.

#### 30. Studies in the nutritive value of yeast fortified drinks.

T. N. RAMACHANDRA RAO and D. S. JOHAR, Mysore.

Yeast is one of the richest sources of B-complex vitamins. With a view to increase the food and nutritive value of beverages 2% autolysed yeast into various new drinks have been incorporated. Some of them, apart from the syrup have been further enriched by the addition of fruit juices also. Estimation of thiamine, riboflavin and nicotinic acid by the microbiological assay method in these drinks have been carried out. The keeping qualities and organoleptic tests have been carried out. The results indicate the possibility of enriching drinks in nutritive value by these techniques.

#### 31. Malt foods for babies. Part I—Assessment of the nutritive value using growing Albino rats.

M. R. CHANDRASEKHARA, M. SWAMINATHAN  
and V. SUBRAHMANYAN, Mysore.

The nutritive value of malt foods prepared by blending cereal malt (wheat or *jowar* or Ragi malt), low fat groundnut flour, skimmed milk powder and fortified with essential vitamins and minerals has been studied by experiments on albino rats. The malt foods contained about 24 per cent proteins and adequate amounts of essential minerals and vitamins. When the malt foods constituted the sole diet of the experimental animals, the rate of growth of young rats fed on the three different malt foods, was almost the same as that observed on a milk food (consisting of a blend of skimmed milk powder, starch, sugar, hydrogenated fat and fortified with vitamin A, D, iron and copper) containing about 24% protein and adequate with respect to vitamins and minerals. The protein efficiency ratio of the proteins of *jowar* malt food was nearly the same as that of proteins of milk food, at 10 per cent level of protein intake. When incorporated at 10% level in a poor rice diet, *jowar* malt food was found to exert a marked supplementary value to the diet, comparable to that obtained with the same level of whole milk powder. Long term feeding experiments showed that *jowar* malt food was adequate for supporting reproduction and lactation in albino rats.

**32. Seasonal variations in Eosinophil Level.**

B. S. KAHALI and C. L. PATHAK, Jaipur.

Eosinophil cell counts were conducted at 12:00 noon in the peripheral blood of 8 adult male individuals at fortnightly interval by phloxine technique during the session 1955-56.

It has been observed that the eosinophil count is low during winter and rainy seasons. The level of eosinophil cells is highest during hot months of summer. Sudden and severe changes in the temperature often influence the eosinophil level significantly. No definite relationship could be demonstrated between the change in the temperature and the degree of variation in the eosinophil level.

**33. Effect of perfusion pressure on heart rate.**

C. L. PATHAK and B. S. KAHALI, Jaipur.

In the course of investigating the effect of a drug on isolated frog's heart it was noticed that adjustments of perfusion pressure resulted not only in a change in the amplitude of a contraction but it often produced a change in the heart rate as well. This was a rather interesting finding as no reference to such an observation could be found in the literature. The detailed study undertaken in this connection indicates that a definite linear relationship exists between the perfusion pressure head and the heart rate. On increasing the perfusion pressure each time by 10 mm. Hg. from 0 to 80 mm. Hg., it is noted that the heart rate progressively increases upto 30 to 40 mm. Hg. Beyond 40 mm. of Hg. the heart rate declines but remains higher than at 0 to 10 mm. Hg. even upto 80 mm. Hg. It has been concluded that the heart rate is a linear function of the intraluminal pressure upto 30 to 40 mm. Hg.

**34. Direct action of Diamox (Acetazoleamide) on Cardiac Muscle.**

C. L. PATHAK, Jaipur.

The therapeutic value of Diamox as a diuretic in congestive heart failure and fluid retentions of diverse aetiology is well known. There is a general agreement that the diuretic effect of the drug is due to electrolyte wash-out as a result of inhibition of carbonic anhydrase in the renal tubules. A possibility was entertained whether Diamox could have any direct effect on the myocardium. This came out to be true. It has been concluded that the drug has a biphasic effect on the frog heart and a predominantly depressant effect on mammalian heart. The drug influences both the inotropic and chronotropic responses of the cardiac muscle. The drug is basically a cardiac depressant.

**35. Studies on the utilization of fructose, galactose and glucose by diabetic rabbits.**

SACHIDANANDA BANERJEE and E. R. DIVAKARAN, Calcutta.

Comparative utilization of glucose, fructose and galactose was studied in alloxan-diabetic rabbits. Fructose and galactose were rapidly removed from the blood stream after these sugars were administered in both normal and diabetic rabbits. But there was a considerable increase in the true glucose values of blood and increased urinary excretion of true glucose after the feeding of fructose or galactose. Superiority of these sugars as alternate sources of energy in alloxan diabetes is not as encouraging as would warrant from a theoretical consideration of the initial stages of their metabolism.

**36. Certain observations on reproduction and bionomics of Bufo. Melanostictus Schneid.**

B. N. DAS and J. K. MOHANTY, Cuttack.

Certain aspects of reproductive activity and bionomics of Bufo melanostictus Schneid were studied. Systematic dissection and examination in various seasons revealed that although almost cent per cent of the adult female toads' ovaries are studded with ova during the rainy season, at least certain percentage of female animals' ovaries carry numerous ova during the winter and the summer months as well. Male toads of this species were found reactive to the sperm test of pregnancy throughout the year, although their degree of reactivity varied a little during different seasons; this reactivity to sperm test of pregnancy most probably indicates that spermatogenesis more or less goes on throughout the year.

Previously marked toads were caught during the height of the winter and the summer and their behaviour and activities were found normal; this fact shows that this species of toad do not go into hibernation or aestivation under the climatological conditions prevalent in Orissa. Stimulation of vago-sympathetic trunk revealed that the sympathetic is dominant during the winter and reverse is the case during the summer months. This fact further lends support to the conclusion that these animals do not go into hibernation in this part of the world.

**37. On the problem of standardisation of liver preparation (Isolation and Estimation of some shock-producing substances).**

S. K. DUTTA and SRIPATI BOSE, Calcutta.

Four different types of liver preparations were obtained, water extract of the homogenised tissue, 0.15 M saline and 1.0M saline extracts of the homogenised tissue and finally the papain digestion of the liver tissue. From these four different preparations, some toxic and shock-producing substances were isolated and estimated by physico-chemical methods. Histamine, tyramine and tryptamine (or 5-hydroxy tryptamine) were noted to be present in two forms—free as well as conjugated, and the conjugated forms were dissociated on electro-dialysis. These amines were isolated by a resin (cation exchanger) and eluted with dilute aqueous ammonia and then further fractionated on paper under suitable conditions. They were then estimated either spectrophotometrically or by micro-kjeldahl method (Dutta, Sci.Cult. 21, 610, 1956). The effects of these amines on blood pressure in animals have been studied. The other toxic substance was noted to be a basic polypeptide and it could be obtained only from proteolysed liver solution. It was also isolated by a cation-exchanging resin and eluted with dilute hydrochloric acid, purified and estimated by the cetavlon-chloroform method (Dutta, Ind. J. Pharm. 18, 47, 1956; 18, 219, 1956). Biological effects of these basic macromolecular polypeptides on the tissues of the animal have also been studied briefly. Finally the proteoses and proteins could be estimated by the same cetavlon-chloroform method.

Removal of these toxic and shock-producing substances from liver preparations rendered them almost non-toxic even when injected intravenously into animals.

**38. Microbiological Assay of Vitamin B<sub>12</sub> in Pharmaceutical preparations containing Methionine.**

S. R. GHOSH and S. K. DATTA, Calcutta.

Methionine or acetyl methionine was noted to act like cyanocobalamin on Escherichia Coll (Mutant) 301, and so, direct microbiological assaying according to Rose was not found satisfactory, (Bose, Ind. J. Phar. 10, 263, 1955)

although spectrophotometric estimation (Dutta, Proc.Natl.Inst.Sci. Ind. 21, B, 188, 1955) was possible. So for microbiological assay the vitamin B<sub>12</sub> was separated from the other growth promoting factor by a highly basic anion exchanging resin, based upon cross-linked polystyrene containing quaternary ammonium groups. The methionine or acetyl methionine remained fully adsorbed in the column while the cyanocobalamin came out completely in the effluent, which could then be analysed either microbiologically or spectrophotometrically. The whole experiment should be carried out in darkness so as to avoid any dissociation of the CN group or any form of degradation. The results were presented in a tabular form.

### 39. Efficiency of Pulse proteins in Maintaining Liver Xanthine Oxidase in Rats.

G. C. ESH, Calcutta.

Xanthine Oxidase being one of the liver enzymes most susceptible to both qualitative and quantitative variations in dietary protein intake, the influence of pulse proteins on the promotion of xanthine oxidase activity in the liver was studied by feeding them to rats at different stages of growth and maintenance with and without supplementation of essential amino acids. With weanling rats feeding either Bengal gram or Lentil there was no appreciable difference with casein in promoting xanthine oxidase activity in the liver at all levels of protein intake (6%, 12% and 18%) although activity was consistently higher when the pulses were supplemented with methionine. The test diets were fed for a short period of time (10 and 21 days) but still less variation in nitrogen content in the liver was observed in comparison with xanthine oxidase activity. With adult rats, however, the enzyme level with the pulse diets was lower than that with casein diet and this difference practically vanished when the pulses were supplemented with the deficient amino acid, methionine.

Similar Xanthine oxidase activity was observed when either intact pulse proteins or pulse hydrolysates were fed to protein depleted adult rats although intact proteins prompted a higher response than the hydrolysates and supplementation with deficient amino acids resulted greater enzyme activity.

Thus these results tend to indicate that pulse proteins are quite efficacious in promoting xanthine oxidase activity at least when they are fed to a level sufficient to induce growth or maintenance and higher activity is observed when they are supplemented with deficient amino acids.

### 40. Prevention of Selenium Toxicity by feeding Barley.

R. N. ROY and S. K. MAHALANOBIS, Calcutta.

It has been found previously that selenium causes anemia probably by disturbing the digestion process. So prevention of the toxicity by feeding barley has been studied. Rats of Group A which were on basal diet showed an increase of body weight, haemoglobin content and r.b.c. count. Rats of Group B which were given food containing 1 mg% selenium showed marked fall of body weight, haemoglobin content and r.b.c. count. Rats of Group C which received barley with their food, showed marked rise of haemoglobin content, r.b.c. count and body weight. When barley was withdrawn from their diet they showed a fall of r.b.c. count, haemoglobin content and body weight. Rats of Group D showed almost the same result as that of Group C, but the improvement was low compared to Group C. The Group C rats showed a 12% rise of haemoglobin content (average) whereas the Group D rats 8.7% only (average) in the same period. The intensity of selenium toxicity was determined by comparing the average body weight,



haemoglobin content and r.b.c. count of the rats. From the above observations it is concluded that barley can check the selenium toxicity to some extent though the mechanism is not known. It may be due to prevention of selenium absorption from alimentary tract.

#### 41. Selenium and Adrenaline relationship on the Toad's heart.

R. N. ROY and S. R. MAITRA, Calcutta.

Selenium of 0.3 mg in the perfusion amphibian ringer stops the heart in diastole but it returns to normal after a long washing with the ringer. So during this inhibitory period of 0.1 c.c. adrenaline of 1 : 100,000 dilution is given the heart can be restored. Also the action of adrenaline in that concentration is not checked by selenium during the active period of adrenaline. When 0.2 c.c. and 0.3 c.c. of a mixture of 1 c.c. adrenaline of 1 : 100,000 dilution and 1 c.c. selenium of 100 mg% were given the action of adrenaline was not checked. Adrenaline can check the heart from the toxic action produced by selenium. No alteration of pharmacological and chemical properties of adrenaline occurs by application of Selenium and adrenaline mixture so far it is concluded from the experimental observation.

#### 42. Vitamin C on Selenium toxicity on Toad's heart.

R. N. ROY and S. R. MAITRA, Calcutta.

0.2 mg selenium dioxide after application of 5 mg of vitamin C produced diminution of amplitude of contraction of toad's heart without any alteration or rate. 0.3 mg selenium after 5 mg of vitamin C produced the same result. When the heart was inhibited by 0.4 mg. selenium, introduction of 5 mg. vitamin C restored the heart from toxic effect. Mixture of 0.3 mg. selenium and 5 mg. vitamin C produced no inhibition of heart or alteration of rate. Then mixture of 0.4 mg of selenium and 5 mg of vitamin C produced the same result. 0.4 mg selenium is too toxic to toad's heart. Vit. C can counteract the inhibitory effect of selenium upto 0.4 mg. The mechanism is not known. It may be due to stimulation of metabolic activity of the cardiac muscle which is depressed by the selenium.

#### 43. Preliminary observation of Phenylmethylaniline-p-aminobenzene Sulphonate (Sulphomin) on the Toad's heart.

R. N. ROY and S. R. MAITRA, Calcutta.

The drug in very low concentration (1 : 1000, 1 : 100) produces stimulation of heart by increasing the amplitude of heart beat without alteration of rates. But in high concentration (1 : 10) it causes diminution of amplitude and slowing of rate but after washing with ringer the amplitude of the heart beat increases showing stimulation effect. 0.2 c.c. of 2.5% solution (i.e., 5 mg) stops the heart in diastole but after washing it regains to normal. It has no action on vagal endings. On atropinised heart and after cutting the two vagi the same action was noted. It may be concluded that the drug stimulates the heart in low concentration and depresses it in high concentration and acts directly on the myocardium.



**44. Observations on Chlorpromazine-induced hypertension in normotensive and hypertensive rat.**

M. L. GUJRAL and S. C. LAHIRI, Lucknow.

Previous workers have held conflicting opinions regarding the Chlorpromazine-induced hypotension in animals. To elucidate this discrepancy, which might have been due to anaesthetic agents used, effect of Chlorpromazine on unanaesthetized normotensive rat blood pressure was determined by a photoelectric tensometer. Doses ranging from 0.5 mg. to 10 mg./Kg. were given, with average blood pressure fall at the end of one hour ranging from 9.1 mm. to 27.2 mm. The log dose-response curve was linear and the regression equation was  $Y = 11.02 + 14.08 x$ . On chronic administration, tolerance to hypotensive effects developed in 3-4 weeks. On withdrawal of drug for 2 weeks sensitivity reappeared, but on resumption of the drug tolerance again appeared after 3 weeks. Rats made hypertensive by a modified Rau's method (unilateral nephrectomy with plastic capsule on the other kidney) were highly sensitive to Chlorpromazine—more than the normotensive rats. The regression line was linear, and the regression equation was  $Y = 59.4 + 39.96 x$ . The results suggest a thorough clinical trial of the drug in hypertension used alternately with other hypotensive drugs. To our knowledge, this is the first communication regarding the acute effect of Chlorpromazine on blood pressure of hypertensive rats.

**45. The effect of the condensation product of Glucose and Acetoacetate on Ketogenesis by liver with Pyruvate as the substrate.**

M. C. NATH and J. M. KHANADE, Nagpur.

The condensation product of glucose and acetoacetate has been found to prevent ketogenesis by liver of normal as well as diabetic rats when pyruvate was used as the substrate. Endogenous ketogenesis was also prevented. The disappearance of pyruvate is more in presence of condensation product both in liver and diaphragm. Pyruvate disappearance which is much less in the diabetic liver, reaches the normal limit when condensation product is added. In presence of condensation product, overall oxidation in diaphragm, as judged by  $O_2$  consumption and  $CO_2$  output is much higher.

**46. Determination of capillary blood sugar using 0.02 ml. of fingertip blood.**

H. D. BRAHMACHARI and M. KUMAR, Pilani.

A suitable micro-method for the determination of capillary blood sugar has not been described. Such a method, if available, would be of great advantage to hospitals and also to the diabetic patients. Capillary blood is really arterial blood. Normally, a difference exists between blood sugar levels in capillary and venous blood, the former being higher especially after food. Though in diabetes, this relation is altered due to the impaired utilization of glucose by diabetic tissue. A method which seems to be quite suitable for the determination of capillary blood sugar has been developed by using 0.02 ml. of capillary blood obtained by finger prick. The determination of blood sugar has been done by suitable modifications of the original Hagedorn and Jensen's method; calculations being carried out by using a standard reference curve drawn by estimating a number of standard glucose solutions of known concentrations. Preliminary results obtained in ten subjects in fasting condition and after light breakfast have been found to be quite promising.

**47. On the use of buffers in experiments on haemolysis.**

A. C. ROY, Calcutta.

Some workers have strongly advocated the use of buffers in haemolytic experiments and it has even been remarked that most of the work on haemolysis with washed r.b.c. has lost much of its significance because the pH has not been properly controlled.

The pH of the system has a great influence on the haemolytic behaviour of substances, but the reactions of the majority of the common haemolysins are not far removed from neutrality, at least at the dilutions in which haemolytic experiments are carried on. The use of a buffer may appear to be imperative only in those cases, where, as the reaction proceeds, there is a shift in the pH of the system away from conditions of optimum activity. But there is no evidence to show that haemolysis by means of the common haemolysins (including snake venoms in which connection the above remark was made) is attended with any appreciable alteration in the pH of the system. If a suitable buffer was all that was needed, one could not have wished for a better buffer than blood plasma and haemolytic experiments might well have been done with whole blood.

Again, it appears from the work of Holden (Aus. J. Exp. Biol. & Med. Sci., 12, 55, 1934) that the time-dilution curves of copperhead venom on rabbit r.b.c., at pH 5.6, obtained by the use of two buffering mixtures (phosphate and acetate) and also that in normal saline solution, the pH of which was adjusted to 5.6 by means of CO<sub>2</sub>, were all different. It is therefore very difficult nay, often impossible, to separate the effect of the pH from that of the buffering ion, as Hughes (Biochem. J. 29, 437, 1935) has so pertinently observed.

It appears therefore, that the use of buffers is not only not necessary for the study of the large majority of haemolysins, but may even introduce greater complexities, and normal saline prepared from conductivity water would still appear to be the medium of choice in haemolytic experiments.

**48. Action of cobra and Russell's viper venom on the esterase and complement activity of blood sera.**

A. C. ROY, Calcutta.

It was previously reported (Roy, Ind. J. Med. Res., 30, 245, 1942) that animals might be grouped under four distinct heads according to the relative esterase and complement activity of their blood sera. The sera of animals belonging to group I (human, monkey, dog) were characterised by marked complement activity with little or no esterase action. Group II—animals (sheep, goat, ox, buffalo) yielded sera having neither appreciable esterase nor complement activity. Horse and cat (group III) sera had pronounced esterase but no complement action and group IV—animals (guineapig, rabbit) had sera having both strong esterase and strong complement action. It was further shown (Roy, Ibid, 26, 1, 1938) that cobra venom had a pronounced esterase activity but Russell's viper venom had none.

As sera of animals belonging to group II had neither perceptible esterase nor complement activity, the action of cobra and Russell's viper venom on sera representing the three other groups was studied. The venom solution was mixed with the serum and incubated at 37°C, for two hours and then the complement and esterase activity titrated against sensitised sheep r.b.c. and ethyl butyrate respectively, adequate controls being run at the same time.

It was found that cobra venom not only inactivated the complement activity of dog and human sera, but the action of natural haemolysins for nonsensitised

sheep r.b.c. present in these sera, was completely inhibited. It had a retarding effect on guineapig and rabbit sera also, the action being more pronounced in the case of the latter. Horse serum was unaffected in the presence of cobra venom. The viper venom besides slightly retarding the complement activity of rabbit serum and the natural haemolysins present in dog and human sera had no effect on the sera examined.

None of the venoms had any appreciable action on serum esterase.

#### 49. Rauwiloid, reserpine and rescinnamine in experimental auricular fibrillation and flutter.

R. B. ARORA and B. R. MADAN, Jaipur.

It has been reported by Arora and Das (1956) that the drugs which are effective in auricular arrhythmias also possess antiveratrinic property. Since Rauwiloid (purified mixture of total alkaloids of *Rauwolfia serpentina*) and reserpine were shown to exhibit a marked antagonism to veratrine response, it was adduced that these drugs might as well be efficacious in experimental auricular flutter and auricular fibrillation produced in anaesthetised dogs. Rescinnamine was also included in the drugs to be tested for their antiarrhythmic activity.

It was found that Rauwiloid, reserpine and rescinnamine caused a significant prolongation of the refractory period of the isolated rabbit auricles. While the former two drugs were effective in bringing about reversion to normal sinus rhythm in all experiments in the case of long-lasting self-perpetuating type of auricular flutter produced by Crush-stimulation procedure, rescinnamine was only partially successful. In aconitine-induced auricular arrhythmia, 1:1 rhythm was established at a low dosage but larger quantities of the drug had to be administered in bringing the rate below 200 beats per minute. In acetylcholine evoked auricular fibrillation, reserpine and rescinnamine were ineffective, but rauwiloid at 1.5 mg/Kg brought about an immediate abolition of fibrillation.

#### 50. Plaquenil in experimental cardiac arrhythmias.

R. B. ARORA, Jaipur.

Plaquenil, a recently synthesised antimalarial compound, which is chemically 7-chloro-4-(4'-(N-ethyl-N-B-hydroxyethylamino)-1 methylbutylamino) quinoline diphosphate, has been found to exhibit antiarrhythmic activity which is fully equivalent to that of quinidine in auricular fibrillation produced in anaesthetised dogs by the topical application on sinoauricular node of: (1) 5 per cent acetylcholine and (2) 0.05 per cent aconitine and persistent auricular flutter produced by injury-stimulation procedure. It was, however, found ineffective in averting ominous ventricular rhythms evoked by petroleum-ether inhalation followed by challenging dose of epinephrine in dogs and calcium chloride induced ventricular fibrillation in rats. Plaquenil further showed a similarity of action with quinidine in prolonging both the refractory period and conduction time as measured from the Q-T and P-Q intervals respectively of the electrocardiogram of anaesthetised cats.

Acute toxicity studies in mice (LD 50) indicated that plaquenil was less toxic than quinidine.

On the basis of these findings, it is inferred that plaquenil may prove to be of therapeutic usefulness in selected cases of auricular fibrillation and auricular flutter.

**51. Laboratory investigation of *Onosma Bracteatum* Wall.**

P. C. DANDIYA and R. B. ARORA, Jaipur.

It has been seen that the aerial parts of *onosma bracteatum* Wall do not contain any alkaloid. A study of the pharmacological actions of the detannated dealcoholized extract has revealed that it possesses the following actions.

- (1) It lowers the blood pressure in anaesthetised intact animals.
- (2) It depresses the heart diminishing its force and rate in intact as well as in isolated preparations.
- (3) It relaxes the small intestine and tracheal muscles and prevents the stimulating action of acetylcholine on the intestine. In doses in which these actions are marked, the drug does not produce any toxic actions.
- (4) The central vasomotor stimulation has no effect on blood pressure after its use.
- (5) It induces vasoconstriction when limbs are directly perfused.

**52. Local anaesthetic, tissue irritancy and acute toxicity of B-Diethyl-aminoethyl 2:3:5:6-tetra methyl benzoate (McN-A-29-11).**

R. B. ARORA and V. N. SHARMA, Jaipur.

Ortho substitution influences the hydrolysis rate of benzoic acid and makes the local anaesthetic agent longer acting. With this consideration Ortho substituted benzoic acid ester of Diethyl Amino alkanol (McN-A-29-11) was synthesised. The local anaesthetic effectiveness, local irritancy and acute toxicity studies have been carried out in this laboratory.

1. The surface anaesthetic effectiveness was evaluated on the cornea of rabbits and guinea pigs. The minimal and medial effective conc. were 0.5 per cent and 0.15 per cent respectively. 0.5 per cent produced the anaesthetic effect for 55 minutes. The highest conc. tolerated was 1 per cent.

2. The infiltration anaesthesia produced by McN-A-29-11 (0.5 per cent) lasted for 150 minutes.

3. The local irritancy tests were performed by rabbit eye method, rabbit ear method and try-pan blue test in rabbit. The threshold irritant conc. was 1.5 per cent.

4. The intraperitoneal LD50 in albino mice was 180 mg/Kg.

McN-A-29-11 was hence found to be a long acting local anaesthetic with great margin of safety.

**53. Antiveratrinic action of some Coumarin derivatives.**

R. B. ARORA, Jaipur and T. R. SHESHADRI, Delhi.

Coumarin and Coumarin derivatives possess an antiveratrinic action on frog sartorius similar to the well known action of Quinine. The antiveratrinic action of these compounds was determined according to the method of Arora and Krayar (1952) and of Arora (1953) in which the sartorius muscle of the frog is suspended in twin chambers in bicarbonate buffer solution. Supramaximal shocks (40 volts, duration 0.5 milliseconds) are applied to the muscles in the bath fluid by a Grass Stimulator delivering square waves. Veratrine response is produced by Veratridine  $1$  in  $10^{-7}$ . In appropriate concentration these compounds not only abolished the veratrine response but also prevented it by pretreatment of the muscle with these coumarin derivatives.

Amongst these compounds it was discovered that 3-Phenyl-7-methoxy Coumarin was three times as active as Quinine. It shows the same antiveratrinic property in a dilution of 1 in 300,000 that Quinine does in 1 in 100,000. 3 Phenyl Coumarin, 3 methyl Coumarin, 3 Phenyl-4-methoxy 7 hydroxy Coumarin were as active as Quinine and Coumarin, 3-p-nitrophenyl Coumarin, 6 Amino Coumarin, 3 methoxy Coumarin were  $\frac{1}{3}$ rd as active.

#### 54. Changes in affective behaviour produced by lesions in the frontal and temporal lobes.

B. K. ANAND and G. S. CHHINA, New Delhi.

This paper deals with the role of frontal and temporal lobe in the elaboration of affective behaviour with particular attention to the limbic structures. 26 monkeys and ten cats were used for bilateral temporal and frontal lobe surgical and electrolytic lesions.

##### *Temporal Lobe Lesions :—*

(a) Electrolytic lesions in Amygdaloid, Periamygdaloid and hippocampal regions made the animals fearless, non-aggressive and calm. Visual agnosia and psychic blindness were also noted.

(b) Animals with extensive surgical temporal lobe lesions showed lack of localisation in space and direction of sound in addition to psychic blindness, docility, fearlessness and visual agnosia. Only one cat resented patting after operation.

##### *Frontal Lobe Lesions :—*

(a) Animals with extensive surgical lesions of frontal lobe including posterior orbital cortex and anterior cingulate had visual agnosia and appeared to be confused and apraxic.

(b) Animals with lesions in anterior cingulate showed fearlessness, hypomotility and docility.

(c) Animals with electrolytic lesions in posterior orbital surface appeared restless and less fearful. Only one developed slight hyperactivity.

(d) 5 monkeys with surgical frontal lobectomies developed hyperactivity. 3 out of these had involvement of posterior orbital surface. Caudate nucleus was found involved in 4 out of the 5 animals.

#### 55. Control of frontal and temporal lobes over food intake, visceral and metabolic activities.

B. K. ANAND, New Delhi.

The role of central nervous system in regulating food intake and certain visceral and metabolic activities has been long recognised. For a long time interest was focussed on the hypothalamus. Recent studies have suggested that limbic lobe structures in the frontal and temporal lobes are also involved in the higher control of autonomic system. Results of stimulation and ablation studies on the hypothalamus, and stimulation of limbic system have been already reported by us. Extensive surgical and restricted electrolytic lesions involving the frontal and temporal lobes were now produced in 26 monkeys and 10 cats, and their results are being reported.

(1) *Food Intake.*

We previously reported, two opposing mechanisms, 'feeding centre' and 'satiety centre' in the hypothalamus, and also suggested that in animals with higher encephalisation (primates). Such a control was also mediated through higher centres. Present results indicate that frontal lobe lesions including the posterior orbital cortex, or restricted to orbital cortex, lead to a decrease in food intake, while those sparing the orbital cortex lead to increase in intake. Amygdaloid and periamygdaloid lesions produce temporary aphagia for a few days, after which the intake returned to normal. Extensive temporal lobe destructions produced an increase in food intake. Changes in food intake were never so marked as after hypothalamic lesions, they tended to return to normal after sometime, and the pre-operative variations in food intake disappeared. It is concluded that forebrain has a discriminative mechanism (appetite), while the hypothalamus has the primitive mechanism (hunger).

(2) *Circulatory Changes.* There was a fall in blood pressure and rise in heart rate after frontal lesions, and a rise in B.P. and fall in heart rate after temporal lesion.

(3) *Rectal Temperature.* There was slight fall after frontal lesions.

(4) *Respiration Rate,* generally fall after both frontal and temporal lesions.

(5) *Gastro-intestinal Tract* showed hyperaemic and ulcerative changes in the mucosa. One monkey had ballooning of gut.

(6) *Blood Sugar and Blood Sodium* levels increased slightly in the majority of animals. Some registered a slight fall.

(7) *Eosinopenic responses* to stress indicated non-involvement of these regions in the nervous phase of ACTH secretion.

## 56. Copper content of blood and liver of farm animals from different parts of India.

S. N. RAY and A. W. ZUBAIRY, Izatnagar.

Examination of liver samples of goats and sheep from slaughter houses at different parts of India, revealed a subnormal content of copper. Blood samples from various farms also revealed sub-acute copper deficiency at several places.

## 57. A study on Carotene Assay Techniques.

B. N. MAJUMDAR, N. D. KEHAR and B. N. GUPTA, Izatnagar.

A comparative study was made of a few widely-employed methods of true carotene assay in feedingstuffs. A method based on extraction in the cold in a Waring Blendor followed by chromatography over Mann's bonemeal is described. This was adjudged to be the best amongst those tested and was found to give reproducible results and maximum recovery. In the case of dry or semi-dried feeds, a slight modification was considered helpful. This method eliminates any loss of carotene due to heat digestion (isomerization), used in certain methods, and is less time-consuming.

## 58. A feed survey of cattle at Nagaur and Bikaner (Rajasthan).

B. N. MAJUMDAR and N. D. KEHAR, Izatnagar.

A qualitative and quantitative survey was conducted of the actual feeds consumed by cattle at the Government cattle breeding farm, Nagaur, in the month of May, 1953. The animals were also clinically examined. The latter revealed wide-spread presence of corneal ulceration; Lymphadenitis and nervous symptoms were

also common. Hurdle test for night blindness proved that nearly 40 per cent animals of the herd were suffering from it. Samples of feeds and fodders were chemically analysed. It was found that while quantitatively protein and minerals were not much below their requirements, except at times, the vitamin A (carotene) supply was grossly deficient or nil over a long feeding period. This was conspicuously brought out by an examination of samples of milk, cream and liver of animals autopsied, which were free of any traces of vitamin A or carotene.

Similar surveys conducted at a few Gowshalas in Nagaur and Bikaner did not show such an acute deficiency. This was traced to the small quantity of dried green Ber (*Zizyphus jujuba*) leaf, Sewn (—) and early-cut jowar (*Andropogon sorghum*) hays included in the ration. Mineral deficiency, however, was common and perhaps protein too.

**59. Studies on the Reichert, Polenske and Iodine values of pure and adulterated ghee.**

B. N. MAJUMDAR and N. D. KEHAR, Izatnagar.

Forty six samples of genuine cow ghee and 43 of adulterated were analysed for R. M., Polenske and iodine values by the standard methods. As far as practicable, the analyses were carried out in duplicate and their averages were used for calculation.

For genuine ghee, R. M. values ranged between 23.92 and 37.16 with an average of  $30.47 \pm 0.48$ . Adulterated ghee, on the other hand, showed a lower average viz.,  $26.13 \pm 0.46$ , having a minimum of 20.53 and maximum of 31.33. The average Polenske values of genuine ghee, e.g.,  $1.73 \pm 0.04$  was likewise higher than that of the adulterated samples, which was  $1.42 \pm 0.04$ . The range of variation was between 1.14 and 2.32 in the case of genuine ghee and 0.92 and 2.17 in the other case.

Iodine values, however, showed a reverse trend. In this case, the adulterated ghee samples had a higher average viz.,  $35.32 \pm 0.43$  compared to the average,  $30.47 \pm 0.48$  obtained for the genuine samples. The range in the first case was from 29.44 to 41.38 and in the other from 24.71 to 35.48.

**60. Studies on the effect of feeding Isocaloric rations containing oil cakes on the digestibility of nutrients and T.D.N.**

N. D. KEHAR, P. C. SAWHNEY and B. SAHAI, Izatnagar.

Observations on the effect of different levels of fat in til cake (*Sesamum indicum*) were reported from these laboratories last year. A similar experiment was performed with linseed cake. The first group was fed solely ghani pressed cake. The second and the third groups were fed expeller pressed and solvent extracted linseed cakes and the rations were made isocaloric group by adding adequate quantities of maize in the II and III groups.

The fat levels in the three groups were 3.54, 2.22 and 0.78 per cent respectively.

It was observed that the utilization of total digestible nutrients in all the 3 groups was approximately of the same order. This confirms our previous feedings.

**61. Studies on feeding linseed (*Linum usitatissimum*) cake pressed by different methods on (1) digestibility of Proximate principles, (2) milk yield and (3) fat production.**

N. D. KEHAR, P. C. SAWHNEY, P. T. VARANDANI and B. SAHAI, Izatnagar.

The results of investigations on the effect of feeding sarson (*Brassica campestris*) cake prepared by different methods on the digestibility of proximate principles, milk yield and fat production in Haryana cows were reported last year. In view



of the importance of the subject, similar studies were made using linseed cake. The first group was fed a concentrate mixture consisting of 50 parts solvent extracted linseed cake, 30 parts gram husk, 10 parts barley and 10 parts crushed gram. The 2nd and 3rd groups were given expeller and ghani pressed linseed cakes in place of solvent extracted cake respectively.

In order to get an overall picture on the comparative effect of feeding oil cakes prepared by three different methods on production of milk, total fat and F. C. M. the data of the two experiments on mustard and linseed cakes was pooled on the basis of processing and the results indicated that (1) the total fat production was higher in the ghani pressed cake group than in the other two groups and the combined results tended to approach significance; and (2) the milk yield and fat corrected milk also showed a trend similar to total fat, although the difference between the groups were not significant.

## 62. Chemical composition and nutritive value of *Imperata cylindrica* grass hay—flowering stage I.

N. D. KEHAR and M. M. JAYAL, Izatnagar.

*Imperata cylindrica* is a perennial grass which is found in abundance in the 'Tarai' regions of the Himalayas.

The percentage composition of the hay (on dry basis) was found to be: crude protein, 3.82; ether extract, 0.72; crude fibre, 39.68; nitrogen free extract, 47.93; total carbohydrates, 87.62; ash, 7.84; calcium (CaO), 0.46 and phosphorus (P<sub>2</sub>O<sub>5</sub>) 0.22.

To study the digestibility and nutritive value of hay *Kumaoni* bullocks and buffalo-bullocks were fed on rape cake and wheat *bhoosa* in addition to the hay. The *Kumaoni* bullocks showed the following digestibility coefficients; crude protein, 24.64; ether extract, 26.32; crude fibre, 27.41; and nitrogen free extract, 41.01; whereas the buffalo bullocks gave the following coefficients: crude protein, 31.12; ether extract, 32.77; crude fibre, 35.41 and nitrogen free extract, 53.21. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of the dry material were found to be 0.94, 31.89 and 8.74 for *Kumaoni* bullocks and 1.19, 41.00 and 18.13 for buffalo bullocks respectively. The animals displayed positive balances for calcium, phosphorus and nitrogen.

## 63. Chemical composition of oil cakes prepared by ghani, expeller and solvent extraction processes as affected by storage.

N. D. KEHAR, P. C. SAWHNEY, M. L. MATHUR, P. T. VARANDANI and K. NATH, Izatnagar.

Investigations were undertaken to study the effect of prolonged storage on the chemical composition of common oil cakes prepared by ghani, expeller and solvent extraction processes. The oil cakes studied were til (*Sesamum indicum*), Sarson (*Brassica campestris*), groundnut (*Arachis hypogaea*) and linseed (*linum usitatissimum*). The results were shown as under:

(a) In the case of solvent cake, chemical composition did not appear to be materially affected by storage except in the case of til cake, where a decrease in ether extract accompanied by minor changes in total carbohydrates was observed for the first four months.

(b) As regards ghani and expeller pressed cakes, same trend was noticeable in both the cakes i.e. ether extract decreased with consequent increase in total carbohydrates upto a certain period and there after the values remained constant.



The periods upto which changes occurred were respectively for groundnut, til, mustard and linseed 5, 12, 12 and 12 months for ghani cakes and 4, 11, 6 and 12 months for expeller cakes.

It, therefore, appears that the constituent mainly affected during the storage of oil cakes is ether extract which decreases with consequent increase in total carbohydrates.

#### 64. Physiology of Coronary Occlusion (Its Bio-Chemistry and Mechanism).

J. N. MAITRA, Calcutta.

I. Introduction :—As students of Physiology we know how the end-arteries terminate and how the arteries without capillaries and veins contract and dilate. The highest filling in diastole and a high diastolic pressure stagnates blood, no matter what is the systolic pressure. Every systole presses blood out and every diastole presses in blood and this mechanical process directly influences the flow of blood through the patent and freely collapsible Coronary tree. Now, if there is any impediment to passage of blood through the lumen, physiological anomaly ensues. High fatty diet, high protein diet, high Calcium food after an age together with poisons of the nature of nicotine etc. and catabolites of different foods and drugs act as poisons.

II. Coronary Circulation :—On coronary circulation depends the health of the heart. It requires its nutrition and hence the first two branches from the first part of the Aorta are the coronary arteries. As these two arteries supply nutrition to the heart, so vasa vasorum supply the aorta and big vessels. By various experiments it has been established that systolic push sends blood to all tissues, the diastolic relaxation pulls blood inside the heart through the pulmonary arteries. Any rise above 90 mm Hg obstructs blood flow through the coronaries and hence is the symptoms of dyspnoea and venous engorgement. We then get the Jugular pulse and digitalis is called for to increase systolic output, eliminate by increase of kidney flow and the heart and there is the business of Blood to keep the vital fluid in bank and that is the physiological reserve of food for others in need. Physiology of coronary circulation is thus so important for the preservation of life.

III. Bio-chemistry :—Occlusion of coronary arteries has called for many physiological remedies, that have now produced opposite results in the hands of apothecaries and doctors without upto-date physiology study. My plea is that a surgeon, an anesthetist, a consulting physician must have up-to-date knowledge in Bio-chemistry. He must know how Cholesterin Calcium, Collagen, and various catabolites can interfere with normal functions of the body-politic.

IV. Physiological Management and Rehabilitation of Coronary artery involvement :—A full and comprehensive study from Physiological point of view of a person of any age complaining of pain in the Chest, oppression on the Chest, dyspnoea, Effort Syndrome and complaints mainly at rest with or without hypertension must be thoroughly examined at intervals of every 3-4 months for ECG, X-rays for heart shadow, biochemical findings for cholesterin, Calcium content of blood with protein and non-protein moiety of nitrogen together with essential and non-essential amino acids for finding data for Collagen Disease that is being talked about, and special study of S-T segment and study of Q in lead I and Chest leads and finding of K, Na, Calcium and Magnesium in blood.

Armed with these findings the person should be given if required physiologic counter-irritation, or physiologic vasodilator of the coronaries e.g. 2% Hydrocyanic acid in 2-5 minim doses to induce physiologic action and there are many of the theophyllin group. Finally, physiologic recipe for sleep for 10 hours, interchangeable occupation and after all hope and encouragement to live upto 100 years.

**65. The effect of L-Thyroxine on Carotene and Vitamin A Metabolism in the Buffalo.**

R. CHANDA, Calcutta.

$\beta$ -Carotene and xanthophyll content of 26 samples of berseem were determined by chromatographic separation of the carotenoids. Tocopherol content was also determined in the same samples. It was found that both  $\beta$ -carotene and tocopherol content of berseem are positively correlated with the protein content. The ratio of xanthophyll to carotene was, however, negatively correlated with the protein.

When lactating buffaloes were subjected to a carotene-free diet for a period of 3 weeks, vitamin A ester in both the blood serum and milk fat was markedly decreased. On realimentation with green berseem which provided about 1000 mg.  $\beta$ -carotene daily to each animal the vitamin A ester content of blood serum rose from an initial figure (Carotene-free period) of 10 i.u./100 ml. to a value of 31 i.u./100 ml. in the two control buffaloes. Similarly the vitamin A ester in milk fat rose from a value of 22.5 i.u./g. fat to 33.8 i.u./g. fat. In the two buffaloes which parenterally received 5 mg. L-thyroxine daily during a 4-week period, the blood vitamin A ester increased from 11 i.u. to 43 i.u., and the milk vitamin A ester from 21.7 i.u. to 40 i.u. The corresponding increases in the two buffaloes, which received orally 80 mg. L-thyroxine daily during the same treatment period, were from 12.5 i.u. to 52 i.u. in the blood serum, and from 22.3 i.u. to 44.3 i.u. in the milk fat. L-thyroxine, therefore, caused a greater increase in the vitamin A ester content of both the milk and the blood serum, presumably by stimulation of the activity of the enzyme system responsible for the intestinal conversion of carotene to vitamin A. A notable feature of findings was that the hormone given orally gave better response than the parenteral treatment.

Vitamin A alcohol was not detected in buffalo milk fat. The hormonal treatment of buffaloes caused increases in the vitamin A alcohol levels in their blood serum.

The results are discussed in relation to the absorption and secretion of vitamin A, and to the mobilization of liver vitamin A ester as vitamin A alcohol into the blood.

**66. Fractionation of Rauwolfia alkaloids by counter-current distribution: an analytical approach.**

G. P. SEN, R. P. BANERJEE and M. L. CHATTERJEE, Calcutta.

An attempt was made to fractionate the alkaloids from *Rauwolfia Serpentine* Bench (non-oleoresin fraction) by means of the technique of counter current distribution in a 80—tube Semi-automatic Craig's apparatus. Of the eight different fractions obtained by successive distributions between phosphate buffers of pH's 4.7 and 5.6 and phosphate solutions of pH's 3.0 and 1.8 as the upper phase solvents and chloroform as the lower phase solvent, four appeared to be pharmacologically potent. Three of them were identified as ajmaline, serpentine and serpene respectively by means of the technique of circular paper chromatography on Whatman 3 filter paper with water as the developing solvent in an atmosphere saturated with acetic acid-water vapour. The latter method was utilised as a relatively simple and effective means of check of the purity of different fractions obtained by counter-current distribution. The identity of the different alkaloids was corroborated by parallel distribution studies with pure and authentic samples of the alkaloids.

**67. Effect of kopsin on the blood pressure.**

A. K. MAITI and S. R. MUKHERJEE, Calcutta.

This has been studied in cats anaesthetised by urethane. As compared to control studies with Ringer's solution (pH 6.5 to 7.4), the intravenous injection of kopsin solution is followed by a definite reduction in arterial blood pressure. The extent of the fall in blood pressure from the original level (150-140 mm. Hg.) was more than 15-20 per cent when the dose injected was small (1-2 ml. containing 1 mg. per ml.). As the dose was increased, there was about 30 percent fall in blood pressure.

Following bilateral vagotomy similar changes were observed. In addition to above when the carotids were occluded and the original level of blood pressure was high (170 mm. Hg.) a similar fall of blood pressure was observed by the intravenous injections of kopsin. Within 4-6 seconds after the administration of kopsin the blood pressure starts falling and the maximum fall observed was 30 per cent which again comes to normal level slowly.

These observations suggest that the blood pressure lowering effect of kopsin is a direct result of interference in cardiac output. During such experiments the effect of strychnine and adrenaline have been studied. Kopsin does not influence the effects of adrenaline. Strychnine has caused increase in blood pressure 10-15 per cent in our experiments.

**68. Comparative studies of Strychnine and Kopsin on Spinal Cord.**

A. K. MAITI and S. R. MUKHERJEE, Calcutta.

The muscle nerve preparation was done including the spinal cord, from the adult toads (*Bufomelanostictus*) and two such preparations were placed in the double myograph chamber so that the effects of strychnine and kopsin could be studied simultaneously.

Strychnine as compared to control normal, definitely increases the excitability and irritability of these preparations as studied by the amplitude of muscle contraction. Fatigue naturally ensued soon. Kopsin as compared to normal control increased to a slight extent only the excitability and irritability of the preparation resulting in delayed fatigue of the muscle.

Identical strengths of the solution of kopsin and strychnine were used in such studies. Strychnine was definitely stimulant to the spinal cord where kopsin possessed very little effect as such.

Kopsin has been obtained from kopsicum and in its structure, it is related to strychnine.

**69. Effect of Kopsicum on the Cardio-vascular system of Toad.**

P. K. DEY and S. R. MUKHERJEE, Calcutta.

**A. On heart.**

By direct perfusion on the heart preparation or by injection of Kopsicum solution into the superficial abdominal vein, changes in the heart rate and amplitude of contraction were studied.

In various small doses ( $2 \times 10^{-5}$  to  $1 \times 10^{-6}$ ) very little effect was observed as the dosage increased, the rate gets diminished as well as there is diminution in the amplitude of contraction. These effects follow a few seconds after administration or application of the chemical.

When the dosage was increased ( $1 \times 10^{-2}$ ) these effects on the heart were very marked and the heart stopped beating for few seconds.

Recovery follows quickly with the washing by Ringer solution and the initial stage of recovery period for 10 to 15 seconds there was an increase in the both rate and amplitude of contraction. Vagal block by atropine did not influence these results. Previous application of adrenaline also did not influence this action of Kopsicum on heart.

#### B. Vascular System.

The blood flow through the peripheral vascular bed in the hind limbs as well as the whole body was studied by (i) venous drop recording technique, and, (ii) by flow pressure perfusion technique.

Such studies indicate that whether the pressure of perfusion fluid remains constant or varying the blood flow pattern, when perfused by Kopsicum is almost similar to that perfused with ringer solution of pH 6.5. Therefore, Kopsicum acts centrally only.

### 70. Effect of Kopsicum on the smooth muscles.

P. K. DEY and S. R. MUKHERJEE, Calcutta.

Kopsicum resembles in certain respects with strychnine. Its effect on smooth muscles has been studied by bathing the intestine and uterus of guinea pig in Dale's bath. As Kopsicum solution used was of pH 6.5, control studies were made by using ringer solution of pH 6.5 and 7.4 respectively.

Results of such studies showed that Kopsicum stimulates the smooth muscles of both intestine and uterus. Small intestinal segment was used in these experiments.

When strychnine solution was used to compare its effect on the smooth muscles, no effect was observed.

### 71. Anti-histaminic action of alkaloids of *Rauwolfia Serpentina* Benth.

M. S. DE and M. L. CHATTERJEE, Calcutta.

A 2% hydrochloric acid extract of the alcoholic percolate of *Rauwolfia Serpentina* Benth was fractionated by the technique of counter-current distribution. One of the fractions ( $B_7 + B_8$ ) exhibited antagonism against histamine as tested on isolated strips of guinea pig ileum in Dale's bath. The drug nearly inhibited the histamine action ( $10^{-8}$ – $5 \times 10^{-8}$  g/ml.) at a concentration of  $10^{-8}$  g/ml. The action was found to be much stronger as compared with the total soluble alkaloids.

## **SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCE**

*President* :—DR. S. M. MOHSIN, M.A., Ph.D.

### *Abstracts*

#### **GENERAL AND EXPERIMENTAL PSYCHOLOGY**

##### **1. Some studies of the bow-shaped error function.**

V. K. KOTHURKAR, Poona.

The aim of the present study was to see which of the particular arrangement of the five different kinds of items gives the levelmost positional error curve. A collateral purpose was to see if any general form of the error function emerges through a systematic variation of the pattern and the actual placement of items. Standard Deviation is accepted as an index of the level or the bow-shaped character of the error function. The smaller the S. D. the more nearly level and less bow-shaped is the function.

Six equated groups learnt six lists of ten identical items in different arrangements. Mean errors at each position are calculated and S. D's are worked out. The graphs are plotted.

The mean number of errors under all arrangements of these five different kinds of materials are generally low as compared with the typical error function with uniform non-sense materials. The arrangements of elements of lists I and V give two minimum mean errors and also give two smallest S.D.'s.

Within the limits of this experiment, maximum depressing and flattening of the error function is achieved in lists I and V with mean errors 3.23 and 3.06 and the S.D.'s 0.84 and 0.91 respectively. The general shape of the error function is indicated by the curve embodying the data of all the 48 subjects with mean errors 3.39 and S.D. 0.81.

##### **2. A Comparative Study of Reminiscence Effect in whole and part learning of Paired Associates.**

ROSE MILLIAN, Shillong.

This short study of Reminiscence Effects in whole and part learning of Paired Associates is based mainly on my personal findings and collection of data from the Madrasse Girls of Class VII and VIII aged between 12 and 14 years of the National High School, Calcutta.

Various experiments have been made on this line by Ballard, Crafts, Davis, Meenes, Warner, Brown and others. The main interest in this study has been to find out new points of interest in the details of observation and to verify the results of the previous experiments. So my aim is to reveal the reminiscence effects of paired associates not only by whole method of learning but by part method as well and to find out their relation.

**3. A new approach to Experimental Aesthetics.**

A. K. SARKAR, Calcutta.

To verify Prof. S. C. Mitra's hypothesis in the field of form-aesthetics, the experiment was carried out. Ten pairs of forms were drawn on white cardboards in which ten forms had a vague association with human body-forms. These were presented to 30 subjects pair by pair. They were asked to look at the forms carefully and passed their opinion in favour of one form of the pair, which they preferred most. Later, the subjects were asked to give their reasons for the preferences.

The results obtained in this experiment were in agreement with the hypothesis that the forms which were preferred by majority of peoples were associated with human body-forms. The reasons given by the subjects in favour of their preferences also confirmed this view. Out of total 300 judgements from 30 subjects, 152 judgments were passed due to association with human body-forms. Along with other reasons as their personal main view-point in their preferences, 21 subjects expressed that association with human body-forms played an important part in their preferences. No rigid conclusion was made. It was expected that the findings would be verified by other enthusiastic research workers.

**4. Muller-Lyer effect under two conditions.**

NIROD MUKHERJI, Gauhati.

With the end in view of ascertaining possible difference in the M-L effect 38 subjects were used with the instruction to equate the figure bearing the oblique lines extended out (variable) with the figure bearing the o.l.s. pointed inwards (standard). Retaining the length of the o.l.s. the same in the standard, those in the variable were increased keeping the angle between the o.l.s. and the central line the same. It was found that with the increase in the length of the o.l.s. displacement decreased. If, however, o.l.s. in the variable were tilted in the direction of the central line, displacement was significantly enhanced.

Further, it was demonstrated that the figures if were kept in the same condition, changes in the background lighting conditions brought out highly significant difference in the magnitude of displacement: under low illumination there were larger 'errors' than when the intensity of illumination was increased.

**5. Estimation of Short Temporal Duration in Two Sense Modalities by the Method of Reproduction.**

RAM GOBINDA CHATTERJEE, Calcutta.

The paper reports the result of estimations of five time durations viz., 0.20, 0.40, 0.60, 0.80 and 1.00 seconds. Each stimulus time was presented five times in succession to a group of five subjects, one by one. In one case the presentations were in the form of a continuous light stimulus of low intensity and in the other the durations were in the form of a continuous sound of milder intensity. Each subject estimated the stimulus time first with the visual presentation and then with the auditory one. The observations of the subjects were recorded on the smoked surface of a revolving drum. The mean estimations in the two experiments show a similarity in that all the stimulus durations have been overestimated. The relation between the two estimations at a particular stimulus time is high and significant as measured by the correlational method. The experiment points to the conclusion that estimations do not differ in the visual and auditory presentation though a reverse trend appeared with interval estimation.

**6. The Role of Dominance in perceptual phenomena.**

NIROD MUKERJI, Gauhati.

A reference in perception seldom appears in isolation; this does not mean that perception results from mere conglomeration of the diverse referents reflected in the sense data. Instead of operating in an additive manner they show functional causal relationship. Some referents, particularly in visual perception, are inseparable, e.g., the length and breadth of an object. It can be demonstrated that one of these aspects dominates over the other to produce the total effect. To determine the functional relationship of the various referents with precision and in stable terms is the primary object in the present-day psychophysics.

**7. A methodological analysis of the concepts "Personality" and "Attitude".**

RHEA S. DAS, Calcutta.

In its main development, the psychology of personality has grown independently of the psychology of attitude. While the psychology of personality grew mainly out of clinical investigation, the psychology of attitude can be traced mainly to sociological origins. The interrelationship between personality and attitude has been receiving increased research attention in recent years. If the published work on the interrelationship of personality and attitude is examined, some confusion is found in the use of the major concepts "personality" and "attitude". In particular, some concept, such as "authoritarianism", may be referred to as a personality variable by some investigators, and as an attitude by other investigators. This confusion may be attributed to three factors: differences in origin, resulting in differences in orientation and method; the complex nature of both concepts; and the failure to relate these concepts to observable events. Two logical tools, reference class and reduction sentences, when applied to the problem make the distinction between attitude and personality operationally meaningful. Through this analysis, personality is seen to refer primarily to the behaviour of the individual as perceived by himself and others, while attitude refers primarily to the behaviour as related to objects in the environment.

**8. Seven Laws of Psychic impressions.**

PREM NARAIN MATHUR, Delhi.

Co-ordinated study of the experiments of Physiological Psychology and other sciences enables us to generalize the following laws:

1. The law of specificity of receptors states that each receptor is capable of being stimulated by a particular form of energy, radiated within a definite range of frequency and wave length.
2. The law of neuro-transformation states that the receptors transform the disintegrated stimuli from the environment into neuro-frequency waves, which are carried from the sense organs to the encephalon.
3. The law of Psychic Transformation states that the brain cells transform the neuro-frequency impulses into Psycho-frequency waves, if the energy involved in the impulses is beyond their threshold potentials.
4. The law of Psychic integration states that the waves formed by the encephalon into Psycho-frequency vibrations integrate to form the object from which the stimuli originated in the environment.
5. The law of Psychic sets states that the process of Psychic integrations is influenced by the wave units already present in the mind.

6. The law of objective influences states that the characteristics and the mode of presentation of the stimuli influence the form, magnitude and other characteristics of the psychic units differentiated in the mind.

7. The law of Psychic Domination states that if the intra-psychic activity exceeds a certain limit at the moment of the arrival of the transformed external stimuli, the Psychic Impressions are different from the reality object—a snake may appear a rope and a rope a snake. There is relativity in Psychic Impressions.

### PSYCHOMETRICS

#### 9. Estimating the probability of chance occurrence of an obtained score in Sociometric-type Tests.

J. C. PRAKASH, Bangalore.

The paper seeks to provide a probability model for estimating the probabilities of chance occurrence of obtained scores in such types of Sociometric tests, wherein multiple criteria are employed and the number of choices allowed on each criterion is either fixed or not fixed.

The assumptions on which the probability model is based are stated and the following cases are considered :

1. Case in which members are asked to choose a 'fixed' number of others.
2. Case in which scores on several criteria are combined into a single score.
3. Obtaining the probabilities of chance occurrence by approximating the binomial distribution to normal form.
4. Case in which it is desired to divide the distribution into above and below a given probability level.
5. Case in which the number of choices allowed is not fixed, or in which all the allowed choices are not utilised.

#### 10. A Note on Reflections during Factor Analysis.

S. JALOTA, Banaras.

Professor G. Thomson and others say that all elements reflected at one stage of factor analysis are to continue with the reversed sign, until re-reflection. But the illustration by Thurston, L.L., *Multiple-Factor Analysis*, pp. 161-70, gives an opposite impression. To decide between these two practices, I have taken the Correlation Matrix for our Hindi Test (34-55);  $N=400$  drawn from 2800. Centroid extraction gave *three* factors. We have followed the two techniques with two sets of factor-data.  $F_1$  has been obliquely rotated by the *extended vector* technique, and a IId order G+Simple Structure obtained in each case.

The results show that when we follow Thomson's technique, the IId order G-values are reduced, but a psychologically *more meaningful simple structure* is obtained.

(The data and information presented herein will not appear in print before the conclusion of the 44th Session of the Indian Science Congress, in January, 1957.)

#### 11. An experiment with construction of tests of interests at the University level.

K. RAY CHOWDHURY, Aligarh.

The main purpose of this paper is to show how to make an experiment with the construction of tests of Interest at the University Level. Measurement of Interest is derived from Self-assessment and Information. There are twelve



hypotheses in each of these tests (one being separated for different sexes, so practically 11 hypotheses in all). The hypotheses are based on Vernon's article, "Classifying High-grade Occupations", *J. Abn. Soc. Psychol.*, 1949. Information Tests were first administered to a group of 43 students, Education Department, Goldsmiths College, London and the item analysis was carried out. Then an experiment was carried out upon a group of 70 post-graduate students, King's College, London. On this group both the information test and the interest survey (i.e. by self-assessment) were administered. Besides finding out the product-moment correlations between Information test and the Interest Survey a pattern-correlation has been calculated with a new formula of Vernon based on Allport-Vernon formula (in Study of Value, 1931) and that of Cronbach (*Psychol. Bull.*, 1953). Suggestions were obtained by this method for finalising the items of the test.

## 12. An empirical study of different reliability formulae.

TAPAS KUMAR SEN, Calcutta.

The present paper attempts to compare the different methods of estimating reliability that are used in judging psychological tests. It also attempts to compare the usual odd-even split against a split into two rational equivalents of a test, made on the basis of judgments by experts on the subject. The data have been collected from five tests used in a Medical Selection Testing conducted by the Christian Medical College, Ludhiana in different centres in India. The number of candidates is about 550.

## 13. Standardization of Iowa Mathematics Aptitude test under Indian condition.

S. CHATTERJI, Calcutta.

The standardization of an adapted version of the Iowa Mathematics Aptitude Test would be discussed in this paper. These tests were applied to about 400 1st year Science students in Nagpur, Madras, Tellicherry, Lucknow and Patna. The validity coefficients obtained with three of these groups, intercorrelation between the different parts of the test, contribution of the part scores in predicting examination marks are included. All the calculations as planned could not be finished by this time and we hope to include them in the final paper which is to be read.

## 14. Scoring and weighting system in performance tests.

B. DAS GUPTA, Calcutta.

Some new statistical procedures have been derived for scoring and weighting in performance tests, in which the raw data is time taken by different individuals in finishing different items and/or the whole test. The problems tackled are :

- (a) The setting up of time limit for each item for individual testing and/or for the whole test for group testing.
- (b) The determination of the maximum score to be assigned to each item.
- (c) The procedure for assigning marks to the individuals, taking into consideration the time taken to complete each item and/or the whole test.

## 15. Should Group Intelligence tests be timed?

A. E. HARPER, Jr., Calcutta.

The arguments for and against both "Speed" and "Power" tests are examined, with special reference to conditions in India. It is concluded that "Power" tests are usually more desirable than highly speeded tests of general intelligence. A

compromise solution is presented by which both "speed" and "power" scores can be derived from a single speeded test. Empirical data is presented relating the two scores to various other measures.

**16. A Pilot Survey of some characteristics of the Progressive Matrices (1938).**

ASIT N. DEB, Cuttack.

It is a pilot survey to ascertain some of the characteristics of the widely used intelligence test. The total number of cases in the sample is 100 college students of the Ravensha College. The students were selected at random.

The students' ages were between 16 to 19 years and were from I to IV year class of the Arts Section and belonged to different socio-economic conditions.

The difference between the means of test retest of the Progressive Matrices (1938) Intelligence Test was found to be significant. There was no indication of any definite relationship between the total score and total time taken to complete the test. The difference between the mean scores of each set was found not to be significant.

**17. Construction of an omnibus type of intelligence test in Oriya.**

ASIT N. DEB and MAYA DEB, (nee-Guha).

The test is a paper pencil type of test constructed with an aim to administer the intelligence test in a group. The total time limit is 20 minutes. The test has been constructed in the 'CAVD' principles. There are 50 items in the final form of the test. These items were selected from a trial series with 150 items. The final form of the test has been administered to 315 students between the ages 16 to 21 years old. The sample is composed of a large proportion of College male and female students.

The mean for the total group is 26.40 and  $SD=7.5$  for  $N=315$ . The reliability of the test score, determined by the method of Rational Equivalence is 0.768 and the Index of reliability or the Correlation between obtained score and true score is 0.87. The validity of the test as estimated by the method of estimation of the true SD works out to be above 6 points.

It is the first attempt to construct and standardise an intelligence test in Oriya language.

## **INDUSTRIAL PSYCHOLOGY**

**18. A Railway study on differential perception of first-line supervisory practices.**

H. C. GANGULI, S. GOSWAMI and R. GHOSH, Khargpur.

The object of the study was to determine (i) the actual practices of the first-line supervisors and (ii) the worker's perception of these practices and attitude towards these.

The sample studied consists of 13 first-line supervisors and 140 workers in the machine shop of a railway workshop.

The method of study was open non directional interviews on the basis of a previously standardised schedule referring, in a rather exhaustive manner, to different aspects of supervisory practices and policies.

The conclusions are : (1) There is close agreement between workers and supervisors regarding what constitutes the important aspects of supervision relating

to productions, (ii) there is considerable difference of opinion between the two groups regarding actual supervisory practices and their significance relating to personnel and human relational problems; (iii) the problem of supervision and change in organisational set-up are not of much significance to the workers, except perhaps in organisations where it is oppressive in nature.

#### **19. Methodological analysis of interview data for personnel selection.**

RHEA S. DAS, Calcutta.

The primary purpose of personnel selection is to predict, from a field of applicants, those who will be most successful if selected. Since the interview is the most common method for selection of personnel in all spheres of business activity at the present time, it must be studied in terms of its accuracy as a selection method. Its dependability will be important to the employer, who expects it to pick out applicants who will be useful for him and reject applicants who will be unsuccessful, and to the employee, who expects it to provide a fair chance for his employment. Improved accuracy and dependability of interviews will result from increased reliability and decreased errors of judgment. To these ends, quantitative rating forms were developed in these studies. The data for these studies indicate that reliability for interviewers is high for most traits used for predicting successful candidates when the quantitative rating forms are utilized. However, certain errors in judgment, such as leniency errors, halo effect, and interviewer-trait interaction, have not been eliminated. It is proposed that these errors can be reduced by proper training of interviewers. The combination of quantitative interview rating forms and training of interviewers should improve the accuracy and dependability of the interview as a personnel selection method.

#### **20. Psychology of Management in the Industrialisation of the country.**

RAMA G. KAMAT.

To establish the proper psychological approach from the side of Management in regard to our industrial development plan, it is necessary that :

1. The administrators, directors, managers and chief executives must have a nationalist background and be perfectly integrated into the philosophical principles of our socialist welfare state.
2. The private sector must obey the trusteeship principles enunciated by Gandhiji, and replace the aim of profit by that of social gain.
3. Where possible, foreign enterprises in vital sectors such as coal, petroleum, tea and coffee must be nationalised.
4. Immediate Indianisation of personnel must be imposed. Only Indians shall be allowed to hold executive posts in industries. Foreigners can work as technical advisers when suitably qualified Indians are not available.

#### **21. Group participation as an effective technique to improve Workers' Attitude and Morale.**

TOPODHAN GANGULY, Calcutta.

This experiment was an attempt to determine the possibility of utilising an active group participation technique in improving workers' mental disposition in a Calcutta factory. The experiment was completed in three stages viz., (i) pre-experimental over-all attitude survey of 310 workers, (ii) action research programme which included both the supervisors' and the workers' orientation programme, and

(iii) post-experimental attitude survey. After the over-all attitude survey, two groups of workers from the same working population and with similar characteristics were selected for further study. Action research programme was taken up in the foundry section which formed the experimental department while the machine shop was kept as control. On the fourth month from the termination of the training programme post-experimental attitude survey in both the departments was taken up to compare the effective value of group participation on workers' morale and efficiency. The same multiple choice type of weighted attitude scale was used in both the attitude surveys.

From a comparative analysis of the results the following conclusions are drawn :

(i) The programme seems to improve the relationship between the different levels of personnel in the experimental group during the post-experimental period. No such change was observed in the control group, (ii) a highly significant 't' test value of 20.5206 shows the difference between the pre- and post-experimental attitude test scores of the group under experiment. This change is for the better. On the other hand, no such significant change is observed in the attitudinal disposition of the control group, (iii) significant improvement in per capita production rate of the experimental group at 0.01 level is observed. A reduction of per capita rejection of the finished product in the experimental group is also noted after training programme.

Thus, group participation is found to be a suitable method of improving workers' morale and efficiency.

## 22. A Study on Supervisory Practices and Policies as Related to Worker and Management Satisfaction.

H C.. GANGULI, S. GOSWAMI and R. GHOSH, Khargpur.

This study is based on a sample of 140 workers and 23 supervisors in a railway workshop. Actual supervisory practices and worker satisfaction with these were obtained from interview of the above sample. Satisfactoriness of each supervisor was gauged by ratings from three of his superiors.

Some of the findings are given below :

(1) Workers satisfaction with his supervisor seems to be related to the way the supervisor feels he is treated by his own superiors. This last point, however, does not correlate with the management's opinion of the supervisor. (2) Similarly, union membership of a supervisor during his rank and file experience seem to be related to the satisfaction of his workers but not of the management with him. (3) Supervisory pressure for maintaining production schedule is inversely related to worker satisfaction but not to rating of the supervisors by management. (4) Supervisors with high worker satisfaction feel that management takes considerable interest in them and appreciates their work.

Analyses of this phenomenon are continuing.

## SOCIAL PSYCHOLOGY

### 23. J-curve Hypothesis and a Statistical Measure of Socialisation.

J. C. PRAKASH, Bangalore.

Divergences from established norms when measured along a continuum, in many cases follow a J-type distribution. The statistic  $\beta'$ , gives a summarising measure of such distributions, with regard to behavioural conformity with the norm. This statistic is termed the 'Index of Socialisation'.

The computation of  $\beta_1$  is illustrated with the absenteeism data of school children from Primary I year class up to and including Middle IV year class.

$\beta_1$  is found, in general, to increase with the increasing age-grade levels of the school children in accordance with theoretical expectation.

The theoretical implications of this result is briefly discussed and some of the hypotheses suggested by theory are stated for further verification.

#### 24. The Religious Attitudes of some Educated Hindus and Christians towards Religion, God and Morality.

NIMAI CHARAN SIRCAR, Cuttack.

This survey was made over 150 individuals from among some educated Hindus and Christians by a random selection not limited to any particular area. The minimum education level for this sample selection was Matric and above. The interpretations are made on the percentage analysis of the answers to different questions in the questionnaire form. The following attitudes have been observed on Religion, God and Morality :

The Christians appear to be very much dogmatic in their attitude towards religion and have definite and rigid views. The Hindus in the majority of cases have taken it as their personal affair and accept the traditional religion either as a matter of course or are quite indifferent to it. The Christians give more or less equal importance to the ethical, supernatural and utilitarian standpoints of religion while the attitude of the Hindus are quite indefinite.

The Christians believe in God, in mysticism in the religious ecstasies while the Hindus are much critical about the concept of God.

Towards Morality the attitude is that the moral rules do not come from a set of standardised codes but they are dictated by the individual's conscience which is on par with the social values.

The present study of these specific ideas of different individuals of the two communities is by no means decisive nor is it complete.

#### 25. A Psychological Evaluation of certain Trends in Indian Culture.

K. V. RAJAN, Lucknow.

The mentally ill are not mere deviants, rather they are pointers showing defects of any given culture. From them the author observed certain aspects of this culture which appear harmful for the development of human personality. In the hierarchical society of India no revolutionary search for truth can come from the younger group, because they are terribly inhibited and afraid of disapproval from the top. The approval seeking has become a necessity under such a condition. The cultural attitude towards the human body is negative. The split between spirit and matter is shot through and through Indian thought. This has created a very unhealthy attitude towards normal sexual feeling and the consequence is great. In India science and superstition co-exist, and the culture has not assimilated modern science which India needs for her development. Without this no original research can take place. At this point of history intergroup reaction is taking place and this has put a strain on the emotional resources of many. Those who are planning for the future of this country have not seen the problem from the psychological point of view. It looks as though the alternative is between better mental health or political chaos; therefore it is time that we took a second look at Indian culture.

**26. Study in Stereotypes of College Freshmen and Service-holders (of Orissa) towards Seven Indian Groups.**

R. RATH and J. P. DAS, Cuttack.

The present investigation made attempts to assess the stereotypes of 100 college freshmen and 100 serviceholders of Orissa towards six Indian out-groups namely, the Bengalees, Biharies, Telugus, Punjabies, Harijans and Adibasis. The subjects were the genuine Oriya inhabitants of Cuttack and none of them belonged to any one of these out-groups. They were also required to choose attributes for their own group. A list of 60 adjectives was prepared for this purpose after necessary pre-test.

Attributes checked by at least 20 per cent of the subjects were selected for analysis. The subjects invariably choose a large number of derogatory attributes for the out-groups and a smaller number for the we-group. The largest number of traits was selected for the Bengalees and the smallest for the Harijans and Adibasis. The rank correlation between the two sets of scores (i.e. the students and serviceholders) in relation to each and every reference group is significant at 1 per cent level. The mean scores of the serviceholders are usually higher but the mean differences are not significant. This means both the samples almost agree in choosing the attributes for the different groups. So it can be reasonably said that both the samples more or less represent the population in expressing the stereotype traits which perhaps are commonly held and widely prevalent opinions in this area.

**27. The effect of Acculturation on the Personality Structure of the Baiga.**

P. C. RAY, Calcutta.

In the year 1956, the writer conducted a psychological survey among the Bhumia Baiga, inhabiting the hills and forests of Dindori in the District of Mandla.

*The Problem* : The problem is to find out the effect of acculturation on the personality structure of the Bhumia Baiga.

*The Test* : Rorschach test which presents to the subject ten symmetrical ink blots was used.

*The Subject* : Owing to the very limited time at the disposal of the writer, the data pertaining to twenty subjects having equal age and age range and representing two places have been used.

*Method of Approach* : (1) *Re* : the test : Some of the randomly selected Rorschach protocols have been compared with the corresponding life history records, and the correspondance between the two has been such that the principles of the test may be applied to the groups. (2) *Re* : the cultural and psychological base line : In view of the nature of the samples, the way of life of both the groups as collected by the writer has been compared with each other as well as their ancestors as obtained from the earlier accounts. It has been found that the groups differ among themselves with regard to acculturation.

It may be said with regard to the psychological base line from which changes in personality structure can be measured that as the groups differ among themselves, an attempt has been made to see whether the personality structure of one group represents a continuation or a shift from the personality configuration of the other.

*Findings* : It has been observed in view of the Rorschach findings that so far the basic personality configuration is concerned, a radical shift in the Personality organization of one group with regard to an important Rorschach determinant has been observed, whereas some other determinants show variations which may be interpreted as modifications.

**28. Unemployment and attitude towards family.**

DURGANAND SINHA, Patna.

A study was designed for making a comparative assessment of attitude of the unemployed and employed towards family. An attitude questionnaire was prepared. It had a split-half reliability of .81. It was applied to a group of 50 unemployed gathered with the help of the local Employment Exchange, and on 50 employed individuals in government offices and business. Compared with the employed, the unemployed were significantly unfavourable in their attitude to the family. The employed were sub-divided into high-earning and low-earning groups, and the unemployed into those who were dependent upon their parents for their maintenance and those who depended upon themselves in finding occasional part-time employment or maintaining themselves somehow. Attitude scores showed that those unemployed but depended upon parents possessed favourable attitude towards family, while the self-dependent unemployed showed greatest hostility. The high-earning employed persons were most favourable in their attitude. The unemployed self-dependent differed significantly from the two employed groups as well as the unemployed dependent group.

There was also an indication that age of the unemployed was a factor determining the attitude. So was the length of unemployment. It was also noted that the salary aspired for was extremely low in the self-dependent unemployed group compared with dependent unemployed group.

The study indicates that unemployment affects individual's attitude towards family. In those cases where the family provided protection and support during the state of unemployment the individual's attitude was very favourable towards family. In cases where the unemployed had to fall back upon one's own resources, unemployment created bitterness towards family. The result generally confirms the findings of Rundquist and Sletto that the previous condition of parental home of the unemployed is an important contributory factor.

**29. Test-retest Variation in answers to personal data.**

DURGANAND SINHA, Patna.

A survey on a sample of 150 individuals in a village was made to study changes in attitude towards Bhoodan Movement as a result of the visit of Vinoba Bhave. Apart from answers to an Attitude Scale, the investigator gathered from them certain information on a personal data schedule two weeks before Vinoba's visit and three weeks after. Original answers have been compared with those obtained during the re-test.

Some interesting variations have been observed. While there is high degree of agreement on replies to questions pertaining to source of income, marriage, occupation, caste, and education, there is considerable discrepancy over annual income, number of children ideal for a family, age, habit of newspaper reading, number of children, economic condition and political affiliations. Further, there is a large number of "no-answer" to the question on number of children. The study of test-retest reliability on these items indicates that there is a definite tendency to give variable replies on some items of the personal data. Certain reasons for this have been advanced. This stresses the need of extra care and scrutiny in gathering information on personal matters to ensure reliabilities of reports on age, children, income, socio-economic status, and the like.

**CLINICAL PSYCHOLOGY****30. An Experimental Study of Rorschach Characteristics of different Cultural Groups of Rural Bengal.**

D. BAGH, Sriniketan.

In this study Rorschach's Ink-Blots have been applied individually to three selected groups A, B, and C; each group consists of ten adults. Group A and Group B belong to an interior village area, Group A has the lowest cultural, educational and social values. Group B is higher than the Group A in all these respects though they do not belong to the highest. Group C consists of school adolescents and comes from the still higher cultural and educational sections of Urban population. All are Hindus.

In rural areas though Group A and Group B live together they show very distinctly different patterns of behaviour in social intercourse among themselves and also in developing interpersonal relations with outsiders. Group A and Group B have many things common in them but still why they differ so much and why not they come nearer to each other? In this study an attempt has been made to find out, whether the two groups show distinctly different Rorschach characteristics that may throw some light on this problem.

Some such differences in Rorschach characteristics have been found that explain why each group shows different social behaviour patterns and attitudes towards each other and also towards outsiders. Though the two groups are living together through ages why belonging to the same religious group culturally they did not come nearer to each other. Do these two groups have characteristic differences in their personalities? Some of Rorschach characteristics that have been found in this study confirms the assumption to slow acculturation process and explain their behaviour patterns in social and interpersonal spheres from the psychological point of view.

**31. Psychic Mobilization.**

PREM NARAIN MATHUR, Delhi.

Psychic-mobilization is the process of energizing the suppressed and repressed sub-conscious experiences due to external stimuli or intra-psychic activity, such that they become conscious-attaining the cognito-amplitude. The re-inforcement into the conscious state is impeded by certain forces which have to be removed, before Psychic-mobilization can be effected, in addition to this, a beam of Psychic energy is volitionally directed and focussed on the pattern under investigation.

A portion of the case of Mr. K. successfully treated by the author illustrates the process :

After re-orientating the dominating thoughts of the pre-conscious level producing confusion, the sub-conscious patterns are taken up by employing a psychic-filter. A Psychic Filter differs from the Psychic Censor, the former is deliberate, conscious and of high therapeutic value, whereas the latter is automatic, sub-conscious and possesses mostly anti-therapeutic value. In the Psychic filter only those thoughts are allowed to come up at a time which are relevant to the particular department of the mind being examined.

The process enables the most unpleasant, sinful thoughts of revenge, hatred, murder and other criminal acts, to come to the consciousness. When learnt the



process also continues at the sub-conscious level and brings within the purview of consciousness some of those thoughts which had been highly repressed. This process is called Psychic-crystallization.

### **32. Social Perversions.**

PREM NARAIN MATHUR, Delhi.

Perversion is that state of the mind in which the energy associated with normal Psychic Propensities is canalized into some undesirable or anti-social, or anti-personal actions. Perversion is the opposite of sublimation. From the illustrative case history of a socially perverted boy, who had become hostile to his family in particular and the world at large in general and who could not adjust himself with life we infer that some of the causes are :

1. Parental neglect.
2. Pampering by the mother.
3. Rigorous control by the parents and their substitutes.
4. Evil associations.
5. Feelings of inferiority.
6. Unresolved personal conflicts.
7. Excessive frustration.
8. Financial difficulties.
9. Conditioned tantrums of early childhood.
10. Feelings of hostility.
11. Disproportionate development of the propensities.
12. The sense of vain glory.
13. Early mal-adjustments.
14. Consummation of un-earned wealth and
15. Egotistic trends.

Social perversions can be cured by employing the four processes—1. Psychic mobilization, 2. Psychic-recognition of the suppressed and repressed units, 3. Psychic disintegration of the undesirable patterns, and 4. Re-orientation.

All criminal and neurotic behaviour is the cumulative effect of various types of perversion, which can be cured by Psycho-therapy and prevented by following the principles of Mental Hygiene.

### **33. Drug addiction.**

N. N. CHATTERJI, Calcutta.

It has been accepted that addiction to drug is a mental symptom but it is not always possible to place this disorder either under psychosis or psycho-neurosis. Most of the workers believe that drug addicts are psychopaths. Rado and Simmel had shown that these cases have close connection with depression though superficially some of them might show symptoms of obsessional neurosis. In this paper I have described a case of pathedine habit who was studied psycho-analytically and the materials thus obtained showed that the case was originally a hysteric with conversion symptoms and when he was about to develop depressive symptoms with delusions the drug habit was formed. The drug habit developed by the patient saved the personality for the time being from the threatening psychosis though it ultimately failed.

**DEVELOPMENTAL PSYCHOLOGY**

**34. Psychological Analysis of Social Behaviour of five-year-olds.**

**PREM PASRICHA, Delhi.**

The purpose of this study was the classification and analysis of the social behaviour of a five-year-old group. The subjects for this study were 27 children in a five-year-old group including 14 girls and 13 boys. Their ages ranged from five years to five years and eleven months. The range of I. Q. was from 96 to 176.

On the basis of a pilot study the variables for study as well as the form of an observation record blank was determined. This blank recorded the children associated with, the type of social interaction and the interaction with the adults in the room.

Teachers who came most in contact with the children were asked to rate each child on variables related to the study as well as on a personality profile. These ratings of the teachers were compared with each other as well as with the scores obtained during observations.

Inter-observation reliability co-efficients were determined by correlating the odd and even day observations while intra-observation reliability was determined by correlating the scores of the odd and even minutes of each observation period.

A classification of social behaviour was attempted according to whether the social contact was child initiated or child received and whether it was a cooperative contact or a quarrel. A count for each child was kept of the total social interactions made and the time spent in social inter-action. Within each of these categories comparisons were made between the scores of boys and girls, younger and older groups and between higher and lower I. Q. groups.

A sociometric study of the individual child and the whole group was made.

**35. A Study of Family Attitudes of Children with Contrasting Socio-economic Backgrounds.**

**ANWAR ANSARI and BHARATI GHOSE, Aligarh.**

A Thematic Apperception Test was constructed with a view to studying differences in family attitudes of children belonging to two contrasting socio-economic groups. To represent the higher socio-economic group, subjects were chosen from a public school for boys and a school for girls of higher income groups, while subjects representing the lower socio-economic group were drawn from two municipal schools, one for boys and the other for girls. Pictures representing semi-structured family situations, which made up the test, were shown to the subjects and responses were taken down in the form of stories. These responses were analysed into types and their frequencies were worked out. An interpretation of the dominant trends in the responses of the two groups to each picture was also attempted.

The results show the following general trends of attitudes :

- (i) Children in the lower socio-economic group take up adult roles early in life;
- (ii) Sense of transgression is different in the two groups;
- (iii) Repression and sublimation of basic emotions with respect to members of the family take place early in the life of the individual belonging to the higher socio-economic group.

**36. Psychological and Educational Advantages of an In-Service Training Programme for Secondary School Teachers.**

EMIL W. MENZEL, Raipur.

The Report of the Secondary Education Committee of 1953 recommends in-service training for teachers, referring to further training of certificated teachers rather than to the initial training process. In view of the very great shortage of trained teachers and training facilities, in-service training could be profitably arranged for Diploma of Teaching and Bachelor of Teaching courses as well. Such a programme has not been seriously considered heretofore because it has been assumed that the training would be inferior to in-residence training. The author briefly outlines a scheme which would provide a training programme which need not be greatly inferior in value to in-residence training in any respect and provides some decided psychological and educational advantages which are not enjoyed by the present facilities. Eight such advantages are listed.

## SECTION OF ENGINEERING AND METALLURGY

*President* :—DR. G. P. CHATTERJEE, Ph.D. (Met.),  
Ph.D. (Phy.), M.I.I.M.

### *Abstracts*

#### CIVIL ENGINEERING

##### 1. On Non-steady Flow and Movement of free surfaces in subsoil flow dynamics.

S. K. ROY, Poona.

For many structures, the analysis of steady state problems in subsoil flow in terms of the Darcy law, and the harmonic potentials has led to satisfactory experimental agreement, and structural stability. There, however, exist cases where the non-steady states, implicit in the flow, as affected by natural hydrologic cycles or specified operative cycles enters in a correct assessment of the phenomena. In this paper, the movement of free surfaces in subsoil flow is analysed in terms of the local accelerations, referring to one case of a simple translational movement by the imposed pressure gradient, and a second case of a movement under gravity, and the resulting percolation flow in the problem of the depletion of a subsoil reservoir. It is seen that the time required for the movement of free surfaces under applied pressures, and incidentally, therefore the adjustment time for the travel of the pressure field can be large for fine materials, and of the order of the time in natural hydrologic cycles. For example, for an operative pressure of 10 ft. of water, and permeability  $1 \times 10^{-3}$  ft./sec. the movement would be 41.5 ft. in a day, and 227.5 ft. in a month. In the problem of the depletion of a subsoil reservoir, it is seen that any normal operative cycle for the movement of free surfaces would induce effective overall pressure gradients in the range of a few tenths with corresponding illustrative draw-off rates, which, for example, is 8.66 cusecs initially dropping to 5.02 cusecs in 3.1/3 hours per 100 ft. length in a typical value of 40 ft. depth of subsoil reservoir, and permeability coefficient  $2.5 \times 10^{-3}$  ft./sec. These give a correct and useful assessment of the flow, and further work on associated non-steady problems would be helpful for the economics and safety of structures.

##### 2. Prestressed Steel Structures.

K. K. BANERJEE, Sibpur.

Very recently attention has been paid in certain European countries to prestress steel structures by means of stretching high tensile wires. Only a few years ago, Prof. Magnel of Belgium gave some concrete shape to this idea by trying to prestress tension members in a steel structure.

In this paper author suggests prestressing a steel structure as a whole and by analytical means shows how saving of steel to the extent of 34 per cent and general improvement in the behaviour of the structure under load are obtained. Several factors contribute to the saving of steel, namely, (a) increase in the range of working stress due to prestressing, (b) reduction of vertical shear due to bending up of the prestressing wires, (c) conjugate action of the structure and the wires. Some difficulty is encountered in fulfilling the requirements of Factor of Safety

but it has been successfully solved. Hence it is concluded that great future lies ahead for prestressed steel structures. Also, existing structures which are considered incapable of carrying present day loading, can be profitably strengthened by prestressing.

A numerical example which is given at the end indicates the procedure to be followed by a designer.

### 3. Studies for prevention of percolation of rain water through sandstone walls of buildings in Kandla Port Project.

B. B. ROY and TARA SINGH SIDHU, Poona.

At Kandla Port Project sandstone available locally has been used in building construction work. The stone masonry walls which vary in thickness from 12 to 15 inches are cement pointed on the outside and cement plastered on the inside. During rains and storms, these walls absorb rain water which beats against them and wet patches are formed on the inside surface resulting in ugly discoloration of the distemper in the rooms. Remedial measure for this was sought. It was found that the stones used are highly porous so that the remedy lay in applying a water proof or water repellent coating on the outer face of the building walls, which would prevent rain water from permeating through the pores. In the laboratory small stone pieces were treated with various solutions known to be water repellents or water proofing agents, and of these a 5 percent solution of silicone in xylene was found most effective in reducing the water absorptive power of the stones.

Masonry walls were constructed with these sandstones as in buildings and some of them were sprayed with silicone on the outside and others were left untreated. The exposed faces were then sprayed with water under pressure at the rate of about 50 gallons per hour to simulate rain and storm conditions. While water passed through the untreated walls within a few hours, no moisture movement was noticeable through the treated walls even when the spraying of water was continued for over 24 hours.

Spraying the outer cement pointed face of the building walls with a 5 percent solution of silicone in xylene has, therefore, been suggested as a remedial measure.

### 4. Detection of Cement admixture in Kankar-lime samples by differential size separation.

DHARM VIR, Kharagpur and RAGHBIR SINGH, Amritsar.

Differential size separation has been utilized as a basis to evolve a technique to detect cement admixture with kankar-lime, a local building material of considerable importance in irrigation and structural engineering in Northern India. The commercial cement and kankar-lime are ground to different specifications of fineness, the latter being somewhat coarser. Based on this difference, the method consists of obtaining a + and a -170 fractions, grinding the former to the same size as the latter, and then to determine the tensile strength of 3-day old briquettes prepared in a standard manner. It is found that admixture of cement to the extent of only two per cent causes a difference of as much as 10% in the tensile strengths of the two fractions. Actual test samples, as well as suspected samples, have been investigated and the conclusions reached fully agree with chemical composition and other characteristics of the respective samples. This method is now being increasingly employed to detect cement admixture with kankar-lime.

## ELECTRICAL ENGINEERING

## Synopsis

## 5. Power problem during the plan periods.

Dr. J. N. BASU, Jadavpur.

India is greatly deficient in generation of electric power mainly due to her industry underdeveloped, though she is fortunate to possess abundant resources both for industry and power generation. This resulted in a low economic condition of the people. A democratic set-up of administration, pledged with socialistic pattern of society cannot but be perplexed with such a state of affairs. Hence it is no wonder that power, industry and agriculture occupy the greatest priority in planning national programme.

The power generation is promoted by 3 types of agencies in India :

- (a) Government and Municipality
- (b) Companies
- (c) Certain industries to meet their own power requirements.

In recent development process, it is the Public Sector that is coming more and more into the field. The electric supply undertakings by private companies are developing at less rate and the self-generating industries are trying to be relieved of power generation problems wherever possible.

This is the trend indicated in the Table II.

The State owned electric supply undertakings increased in installed capacity to 133% during the first plan and 207% in the second plan period, whereas company owned undertakings increased 18% in 1950-55 and 15% in 1955-60.

Table I shows the installed capacity in 1950 was 2.312 million kilowatt increased to 3.4 m.k.w. in 1955 and to be increased to 6.84 m.k.w. in 1960 at the end of the 2nd five year plan.

TABLE I

## INSTALLED PLANT CAPACITY IN K.W. IN INDIAN UNION

In December 1950	Addition during 1st Plan	In December 1955	Addition suggested in 2nd Plan	Expected capacity in Dec. 1960
<b>I. Electric Supply Industries</b>				
(a) Steam Plant ... 1,004,434	550,000	1,554,434	1,000,000	2,554,534
(b) Diesel Plant ... 148,796	60,000	208,796	20,000	228,796
(c) Hydel Plant ... 559,285	400,000	959,285	2,100,000	3,059,285
Total ... 1,712,515	1,010,000	2,722,515	3,120,000	5,842,515
<b>Self Generating Industries</b>				
Industries ... 600,000	100,000	700,000	300,000	1,000,000
<b>TOTAL ... 2,312,515</b>	<b>1,110,000</b>	<b>3,422,515</b>	<b>3,420,000</b>	<b>6,842,515</b>

Table II shows the increment energy generated from 6.5 billion kwh in 1950 to 11 billion kwh in 1955 and 22 billion kwh in 1960.

\* M.w.k. = million kilowatt.

TABLE II

A. Installed capacity in millions K.W.	1950	1955	% increase in 1950-55	1960	% incr
1. Electric supply undertakings					
(a) State owned ...	0.6	1.4	13.3	4.3	20.7
(b) Company owned ...	0.1	1.3	1.8	1.5	15.0
2. Self generating industries	0.6	0.7	17.0	1.0	43.
Total ...	2.3	3.4	48.0	6.8	100.0
B. Energy generation in billion kwh					
1. Electric supply undertakings					
(a) State owned ...	2.1	4.8	12.8	14.5	20.2
(b) Company owned ...	3.0	3.8	27.0	4.5	18.0
2 Self generating industries	1.47	2.4	6.4	3.0	43.0
Total ...	6.57	11.0	67.0	22.0	

The energy generation per capita is 18.3 units in 1950, 30.5 units in 1955 and 60.8 units in 1960.

Capital investment for power during 1950-55 was 250 crores and during the second Five Year Plan Rs. 430 crores including the spilt over of Rs. 160 crores from the first Five Year Plan.

Table III shows the percentage of electricity available in different places with various population ranges. The worst is, no doubt the places with population of 5,000 and less, where 80% of the population live. Hence rural electrification is a critical problem.

TABLE III

## PROGRESS OF ELECTRIFICATION IN TOWNS AND VILLAGES

Range of population	Total Nos. according to 1941 census	Nos. electrified at March 1941	% electrified	Total Nos. according to 1951 census	Nos. electrified	% electrified
Over 100,000 ...	49	49	100	73	73	100
50,000 to 100,000 ...	88	88	100	111	111	100
20,000 to 50,000 ...	277	240	86.8	401	366	89
10,000 to 20,000 ...	607	260	42.7	856	350	41
5,000 to 10,000 ...	2,367	258	10.8	3,101	1,200	38.5
Less than 5,000 ...	559,062	2,792	0.5	556,568	5,300	0.955
Total ...	562,150	3,687	0.64	561,107	7,400	1.32

Compared to U.S.S.R. India had in 1939 as Russia had in 1913 namely, 1 m.k.w. installed capacity and 2 billion k.w.h. generated.

The ratio of installed capacity in 1954 to 1950 in the Union is 1.45 but this is 1.05 in West Bengal whereas the ratio of energy generation in 1954 to 1950 in the Union and West Bengal are 1.45 and 1.4 respectively.

In an industrially under-developed country, power supply is of utmost necessity though it offers multifarious problems of critical nature. Engineering skill and technique is also of prime importance and shall play a great role in the solution of power problems. I hope, we engineers, shall not lag behind to contribute substantially in this respect for the economic uplift of our mother-land.

**6. Magnetic measurements with the Bridged-T Network.**

J. K. CHOUDHURY and P. C. Sen, Jadavpur.

Tuttle's Bridged-T network has been hitherto mainly used as a frequency selective network. Its application in Harmonic Analysers, Selective Frequency Amplifiers and as an equipment for the measurement of high resistance at radio frequency are well known.

The present authors have used the Bridged-T Network for the measurements of Magnetic Loss and A. C. Permeability under different conditions of inductions in the core. The magnetic cored coil has been used as the bridge arm shunting the series arms of a (C-R-C) T-network. The types of magnetic measurements made by the authors include the measurements of: (1) core-loss with varying frequency at fixed induction, (2) core-loss with varying peak induction at fixed frequency, (3) core-loss with superposed direct and alternating inductions in the core, and (4) a.c permeability with varying frequency at fixed induction. The great advantage of the Bridged-T network lies in the fact that one point of the source as well as the detector can be earthed. The network can be used for measurements from power to high audio and radio frequencies. Absence of a complicated earthing system and minimum earth capacity effects gives the Bridged-T network definite advantages over other bridges, at high frequencies.

**7. Application of butterfly circuit and the Transmission line in Wide-band Oscillator.**

S. N. DAS, Calcutta.

The paper describes a wide-band oscillator using a single tank circuit between the grid and the anode of a triode. A semibutterfly circuit is connected to the grid and plate of the triode through a transmission line by a variable inductor formed by two parallel rectangular strips bent in the form of a semi-circle and two variable condensers having semicircular rotors and stators. At the high frequency end, the lines connecting the grid and anode of the valve are used as the transmission line, the semibutterfly circuit being automatically isolated. The transition from the LC mode operation to the transmission line mode operation is smooth because the strips forming transmission line are continued on the same circle as the strips forming the tuning inductance. The range of operation with the present model is from 20 to 450 Mc/s. The frequency range of oscillation can be easily extended in both high and low frequency ends by suitably modifying the circuit parameters.

**8. Effect of different types of ground on the vertical polar diagrams of microwave transmitting aeriels.**

S. S. BANERJEE, J. B. LAL, and P. C. BANERJEE, Banaras.

It has been now known that various types of terrain or ground underneath a transmitting aerial used for microwave communications play an important part in the behaviour of the radiation from such aeriels. Eventually they also show the effects of electrical constants of the ground on the propagation of these waves. In order to study the above effects, a folded dipole aerial was excited at the microwave frequency of about 2 Kmc/sec., and the aerial was connected with a coaxial cable to a matched waveguide at the output of a magnetron oscillator. Mathematical expressions were developed for calculating the field-strengths for drawing the polar diagrams for such an aerial and the intensity of the field



radiated was observed with a germanium crystal connected at the centre of a pick-up dipole aerial. The rectified current flowing through a microammeter connected across the crystal was measured for calculating the field-strength. The microammeter was however kept sufficiently away from the pick-up aerial for avoiding reflections from the body of the meter.

For the sake of comparison of results, metallic or quasi-perfect reflectors were placed below the aerial and polar diagrams were drawn for two selected heights of 1.75 and 2 wavelengths from the ground. These were compared with the polar diagrams obtained with reinforced concrete building materials below the aerial to study the effects of the building roofs on radiation from such aerials. It is found that such type of ground is almost transparent to these waves and as a result the polar diagrams resemble those calculated for the free space. At lower frequencies, in the region of ultra short waves, the behaviour is different as already reported in one of our earlier papers (Jour. Sci. & Ind. Res., 14B, 51, 1955). The results were however confirmed with the polar diagrams obtained for the same aerial in the free space. Various other materials for the ground have also been tried for studying their effects on the mode of radiation from such aerials.

#### 9. A Time-division 2-channel Telephone System.

P. N. DAS, Howrah.

"Time-division multiplex telephone systems have certain advantages from the transmission point of view over the 'frequency-division' multiplex carrier systems which are in general use nowadays. Moreover many costly equipment which are essential in the latter systems, are not required in the systems of former type which are described here. The present paper deals with the principle and working of a 2-channel telephone system on time-division basis and is an introduction to the multiplex telephone system of more channels on this principle.

This system uses series modulator circuits which consist of 4 germanium diodes arranged in the form of a bridge both at the sending and receiving ends of each channel. A carrier voltage known as the switching voltage whose frequency and amplitude are higher than those of the signal to be transmitted, operates each modulator circuit at the sending end in such a way that each speech signal current is sampled like the unidirectional pulse amplitude modulated wave with the impulses occurring in the space periods of the other. The trains of impulses representing the two signal currents which occur in different time periods, pass through the line quite independent of each other. They are separated into the respective trains in the receivers connected in each channel by passing them through similar bridges with the help of similar switching voltages and these trains of impulses operate directly the respective telephone receivers. The same method can be extended to the case of multiplex telephone systems of more channels by suitably positioning the impulses of different trains representing different signals.

#### 10. A Multi-channel Commutator Derived from Binary Scalars in Cascade.

R. PARSHAD and S. K. SINGH, New Delhi.

A binary scaler of scaling ratio  $n$  has in different states comprised of different sets of conducting and non-conducting states of the tubes of the binary stage. Two new techniques have been used to obtain  $n$ -channel commutation, with use of the least number of rectifier elements. The channel capacity  $n$  is split into two factors  $n_1$  and  $n_2$ . By diode gating technique commutation is obtained for

$n_1$  and  $n_2$  channels separately. By using a matrix of diodes for the output channel, and by use of diode-gating technique, the  $n_1$ -channel and  $n_2$ -channel commutations have been inter-combined to obtain the  $n$ -channel commutation.

As an example of what has been done, whereas the earlier technique required sixty-four diodes for sixteen  $n$ -channel commutation, the present techniques uses only twenty-four.

#### 11. An Electronic Technique for Obtaining Successive Long and Unequal Time-Durations.

R. PARSHAD and S. K. SINGH, New Delhi.

A ring of monostable multivibrators has the properties that its functioning as a square-wave generator can be started and stopped electronically (by voltage triggers). Use is made of this fact to generate sets of long and unequal periodic time-durations.

The circuit uses a number of two-member multivibrator rings, each feeding a separate scaling circuit. To begin with, the function of multivibrator ring, one, is started by an external trigger. As the ring circuit goes through its switching cycles equal in number to the scaling ratio of the scaler attached to it, an output trigger at this scaler appears. It stops the functioning of the ring, one, and starts the functioning of the ring, two. The trigger from the scaler is also fed to a binary step-ring counter, whose switching state is advanced by one unit. In their turns all the other ring circuits and the associated scaling circuits go through corresponding switching cycles, till the last scaler has given an output. This trigger stops the functioning of the last ring-circuit and starts the functioning of the first ring circuit. The process thus take place continuously.

The output is obtained from the binary step-ring counter. The output switching durations can be made long and unequal because the corresponding switching durations of multivibrator-rings and the scaling ratios can be made big and unequal.

The whole switching process can be made to go round for a specified number of cycles only, by attaching a scaler to the proper output of the binary step-ring counter. The functioning of the ring, one, is stopped by means of an output trigger appearing from this scaler.

#### 12. Variation of Range and Sensitivity of Electronic Wattmeters.

S. S. BANERJEE, H. SARKAR and T. V. S. MURTY, Banaras.

Electronic wattmeters are useful for the measurement of power in electrical circuits at high frequencies. It is however found that such wattmeters are generally operative over a limited range of power and as such, they become more of academic interest rather than of commercial use. In view of this, study has been made of the conditions under which the range and sensitivity of such wattmeters may be altered. The design of the wattmeter has been so made that it can be used with a common A.C. supply source for the instrument and the load circuit. A sensitive microammeter has been used as an indicator between the plates of two triodes connected in push-pull operating in the square-law region. The use of an external battery for balancing the initial deflection has been completely eliminated. After proper selection of the triodes and adjusting the series resistances in the load circuit the range of the instrument could be considerably increased and the calibration was conveniently made with a standard electro-dynamometer type of wattmeter at power frequencies. The condition for the calibration to be linear has also been studied with resistive as well as reactive loads.

**13. Appearance of double-group back-scattered echoes of short wave radio signals received from the ground.**

S. S. BANERJEE, P. G. SURANGE, and S. K. SHARMA, Banaras.

Double-group back-scattered echoes are sometimes observed after the penetration of ordinary and extra-ordinary waves through the ionosphere when the frequency of a pulse transmitter with horizontal dipole aerial is gradually increased. It has been shown theoretically that these two groups of echoes observed on the c.r.o. screen along with the back-scattered echoes received from the ground after reflection from the  $F_2$  region of the ionosphere, are due to the existence of horizontal gradient of ionisation in the ionised layer. Horizontal gradient of ionisation in the  $F_2$  layer of the ionosphere has been thus calculated from the separation between the two groups of back-scattered echoes, and the result is found to agree well with that obtained from the observations of critical frequencies at vertical incidence over the pulse transmitter and at a station situated on the line joining the scattering centres and the pulse transmitter. The increase of separation between the two groups of back-scattered echoes with the frequency of pulse transmission has also been observed, which further confirms the occurrence of double-group scattered echoes due to the horizontal gradient of ionisation. The accuracy of the results however is limited to the scattering sources situated near the pulse transmitter.

**MECHANICAL AND CHEMICAL ENGINEERING**

**14. The Principal Features of the Control Logic of the Pilot Digital Calculator.**

B. K. BASU, Bombay.

This paper discusses the control logic of the Pilot Digital Calculator at Tata Institute of Fundamental Research by considering in some detail the execution of a single typical instruction. A single machine cycle consists of 2 parts: the first during which the instruction (brought from the memory during the previous cycle) is executed, and the second during which a fresh instruction is transferred from the memory. Each part, in turn, is itself composed of functionally self-contained sections. These sections carry out the individual micro-operations which together make up the given instruction being executed. All the circuits are d-c coupled throughout and the control is completely asynchronous, each operation in turn initiating the next. Some of the advantages and disadvantages of such a control logic are briefly discussed.

**15. The Logical Design of the Pilot Digital Calculating Machine.**

R. NARASIMHAN, Bombay.

This paper describes the logic underlying the systems design of the Pilot Digital Calculator at Tata Institute of Fundamental Research. This is a single-address, parallel machine with an asynchronous control. The 16 built-in instructions include all the 4 basic arithmetic operations, viz., addition, subtraction, multiplication and division. The internal operations are in the binary system. The pilot machine has a fast access ferrite-core matrix memory of about 100 words (of 11 bits each) soon to be replaced by a larger one of 256 words (of 12 bits each). The input-output system consists of standard tele-type tape, a tape perforator and a page printer.

**16. Preservation and suitability of sawdust for being used in Hydraulic Experimental Models.**

S. C. BARAI, Poona.

Sawdust is a very desirable bed material for moving bed hydraulic experimental models where available velocities are not high enough to move sand. But it decays rapidly and forms flocks on the model beds. Experiments carried on to develop methods of preserving sawdust against this decay and flock-formation with different chemicals showed that treating the sawdust separately with limewater, one per cent solution of borax, formaldehyde, or 0.25 per cent solution of sodium arsenite had almost no effect in preventing flock-formation and it was slightly prevented when sawdust was at first treated with limewater and then with any of the other chemicals studied. But flock formed on sawdust treated with one per cent copper-sulphate was quite light and its formation was completely prevented for the experimental period of nine months when the sawdust was first treated with limewater and then with one per cent copper sulphate solution, even though the sawdust was washed thoroughly after the final treatment, and copper left in the sawdust was only 31.5 parts per million.

Experiments carried on with four varieties of sawdusts showed that those from both Burma teak wood and the Country teak wood, were quite suitable as bed materials.

**17. A simple procedure for Internal Control of Silica in Boiler Waters.**

G. V. L. N. MURTY and U. APPA RAO, Jamshedpur.

After outlining the role of soluble silica in internal control of boiler water for avoiding silicate scales, the need for its routine estimation is stressed. A simple colorimetric procedure has been described by which it will be convenient to carry out routine determinations of soluble silica in water samples even with the use of Duboscq type of colorimeters.

**18. Combustion Efficiency of a Gas Turbine.**

S. C. CHAKRABORTY, Calcutta.

Combustion efficiency is promoted by

- (a) good mixing—having the characteristics of
  - (i) Range of inflammability.
  - (ii) Flame speed.
  - (iii) Flame temperature.
  - (iv) Ignition temperature.
- (b) good fuel atomisation—attributed to the viscous forces and the particles size ranges from  $10\mu$  to  $200\mu$  measured by Rosin-Rammler relation

$$R = 100 e - \left( \frac{X}{X_m} \right)^n$$

- (c) high inlet temperature—systems using vaporised fuel injection show better advantages than those having solid injection.

An attempt has been made in this paper to show that the problem of design is basically one of reaching the best compromise between a number of conflicting requirements.

**FUEL TECHNOLOGY****19. Hard Coke from Noncaking Coals.**

D. P. AGARWAL, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

In this communication laboratory experiments to produce hard coke from non-caking high ash Kothaguden coals by three stage process have been reported. In the first stage the coal is subjected to low temperature carbonisation in a 25 ton per day capacity Lurgi Spnelgasplant. The low temperature char so obtained is briquetted at a pressure of 4-6 tons psi. in a hydraulic press using the lime-treated low temperature tar as the binder in the second stage. In the third stage these briquettes are properly matured at 200°C for 2 hours in a mild oxidising atmosphere and then carbonised at a temperature of 900—1000°C for one hour. By this process had coke of crushing strength as high as 1400—1600 psi could be produced.

**20. Briquetting of South Arcot Lignite.**

S. P. MUKHERJEE and S. K. NANDI, Kharagpur.

Briquettes were prepared from South Arcot lignite, the proximate analysis of the air dried sample being moisture—13.3%, volatile matter—46.4%, Fixed carbon—36.8% and ash—3.5%.

Briquettes of the size 1" x 1" approximately were made from -60+100 mesh lignite particles, simply by applying hydraulic pressure at room temperature and without using any binder.

Hardgrove grindability index of briquettes prepared at pressures of 870, 1792 and 3584 p.s.i. was 84, 70 and 66 respectively, almost the same as that of bituminous coal. The total compressive load at which the briquettes crumbled was determined and the crushing strength of the briquettes prepared at pressures of 336, 870, 1792, 2688 and 3584 p.s.i. was found to be 0.006, 0.451, 1.015, 1.691 and 1.914 tons per sq. in. respectively.

Briquettes were prepared at 1792 p.s.i. by admixture of 75, 50 and 25% saw dust with lignite and the crushing strength was 3.384, 2.086 and 1.974 tons per sq. in. respectively.

Combustion of the briquettes could be maintained with ease in a domestic type of oven. Results show that very good quality briquettes can be prepared from lignite.

**21. Oilcakes as Binder for Briquetting of Noncaking Coals.**

D. P. AGARWAL, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

An attempt has been made to utilise the high ash noncaking coal fines or charcoal dust or cokebreeze by briquetting them, using the oilcakes as the binder. Of the five different types of oilcakes tried linseed cake and groundnut cake gave encouraging results, linseed cake being better. Even 5% of linseed cake gave a briquette of crushing strength over 500 lbs. which is sufficiently hard to be used as domestic fuel. When charcoal dust or cokebreeze are used with this binder, practically smokeless briquettes are produced even without carbonisation. Though these briquettes are not water resistant, such resistance towards water could be produced by spraying a very thin coat of bitumen over the briquettes.

**22. Studies on South Arcot Lignite, Part III.**

S. K. CHAKRABORTY and H. N. DAS GUPTA, Dhanbad.

The feasibility of utilising the South Arcot lignite (brown variety), in place of activated chars, has been studied. In all cases air dried and dehydrated samples have been used. The magnitude of their reactivity has been judged by observation of the adsorption of acetic acid and of electropositive dye and these results have been compared with those obtained with commercial carbon samples, viz., carboraffin and Norit. The acid adsorptive property of each sample is of the same order as that of Norit and is undoubtedly superior to carboraffin. Similar behaviour was also shown by the samples towards electropositive dye, the extent of adsorption, however, is comparatively less in the case of lignite dried at 110°C. The practical results obtained after fine grinding are, on the whole, surprisingly small, although grinding is the most obvious way of getting increased area from a given weight of solid. Further experiments with chars from South Arcot lignite are in progress.

**23. Studies on South Arcot Lignite, Part IV.**

M. R. BASU and H. N. DAS GUPTA, Dhanbad.

In a previous communication it was shown that the phenomenon of exchange adsorption is exhibited by air-dried and dehydrated South Arcot Lignite (brown variety). The order of the magnitude of base-exchange capacity, however, is not appreciable and in this respect the value obtained by the authors are not in close agreement with those recorded by Mukherjee, Bhowmik and Lahiri (Proc. Inst. Chem. India, 1956 Vol. 28, Part I, p. 1). The Lignite in the South Arcot Districts contains waxy constituents (Srikantan and Sheney, Jour. Indian Chem. Soc. Ind. & News Ed. 1951, Vol. 14, No. 1, p. 2; Ummer and Reddy, *ibid.*, 1955 Vol. 18, No. 4, p. 193). The present study embraces determination of the base exchange capacity of a number of dewaxed samples and also of samples that have been exposed to 100°C for a long period. The results show that with the removal of waxy constituents from lignite its base-exchange capacity is also altered and that these values for samples, exposed to 100°C for a long period, are practically negligible. Increased pulverisation does not help conferring increased exchange capacity on the lignite samples, rather, the capacity decreases with increased fineness of the material.

**DRESSING OF MINERALS****24. Upgrading of Nut Coal from Kothagundium Collieries.**

K. SESHAGIRI RAO, R. VAIDYESWARAN and M. G. KRISHNA, Hyderabad.

The possibilities of upgrading 'Nut coal' of size 1"—½", having about 19% ash from the Kothagundium collieries were studied, by laboratory float and sink tests. The results of tests on three samples collected from the screening plant indicate that 85 to 95% clean coal is obtained on washing at a specific gravity of 1.60. The reduction in ash is about 3 to 4%. These results cannot be considered as economic for large scale washing.

**25. Washability of Hyderabad Coals.**

S. M. MOHSIN, K. SESHAGIRI RAO and M. G. KRISHNA, Hyderabad-Dn.

The possibilities of Washing Run of Mine coal have been studied by conducting laboratory float and sink tests on (a) No. 3 incline coal and (b) No. 5 incline

coal of Kothagudium. The samples have been screened to various sizes and the tests were carried out on each size, at specific gravities ranging from 1.30 to 1.70. The percent ash in each fraction obtained was estimated. The results obtained indicate that (a) with No. 3 incline coal, when ashed at 1.7 sp. gr. about 85% yield of clean coal is obtained giving a reduction of about 5% in ash content, (b) with No. 5 incline coal when washed at 1.70 sp. gr. 92% clean coal is obtained giving a reduction of about 2.5% in ash. These results cannot be considered as economical for large scale washing of these coals.

## 26. Beneficiation of Graphite from Vizianagram.

K. K. MAJUMDAR, Dhanbad.

Graphite occurring on a hill near the Vizianagram railway station was subjected to beneficiation in the laboratory. The ash forming constituents of the ore were highly disseminated. Therefore, only flotation tests were applied. The ore contained 75.95 p.c. ash, the associated minerals being biotite, epidote, calcite, felspar, quartz, muscovite and garnet. A number of reagents like pine oil, cresylic acid, methyl isobutyl carbinol, ethyl and amyl xanthate, sodium silicate etc., were used in the pH range between 4.4 to 8.8. It was found that cheap reagents like kerosine, cresylic acid and sodium silicate were found superior to other chemicals mentioned. It was easy to obtain a concentrate with about 72 p.c. recovery and ash content varying from 51 to 54 p.c., when the ore was ground to 85 p.c. minus 200 mesh at natural pH (7.8). With the same reagents but at pH 8.6 the ash content of the concentrate is about 46 to 47 p.c. with about 66 p.c. recovery. By floating the concentrate repeatedly, say three times, the ash content of the concentrate was brought down to 28.26 p.c. with a recovery of 51 p.c. at pH 8.6. It was also found that both dry and wet ground ore responded almost equally to flotation. The concentrate is suitable for use as foundry facings and as an ingredient of graphite paints.

## MISCELLANEOUS

## 27. Studies on Delayed Crazing of Earthenware Glaze.

K. B. DAS BHOWMIK, S. K. CHATTERJEE, Calcutta and H. N. DAS GUPTA, Dhanbad.

The delayed crazing may be due to sluggish contraction of the glaze (Mellor, Trans. Ceram. Soc. England, 1934, Vol. 34, No. 1, pp. 1-112) or due to moisture expansion of the body (Wood & Hind, Trans. Brit. Ceram. Soc., 1938-39, Vol. 38, p. 435). The suggested remedial measures against this defect are many and varied. These may, however, be grouped into any one of the following : (i) those endeavouring to subject the final glaze to the highest possible compressive stress without running into the danger zone of "chattering" or "peeling", (ii) by modification of the firing technique, and (iii) by making conditions such as to assist in the formation of intermediate layer between the body and the glaze. Viewed analytically, the ultimate effects of all such measures appear to be similar. The step aiming at increasing the compressive stress on the glaze appears to have received support in the hands of many ceramists. The stress on the glaze has been increased by partial substitution of china clay or feldspar or fluxes of the body by calcined flint, plastic clay, ground pitcher, talc, pyrophyllite, lime and other anti-craze materials. Flint in earthenware bodies is readily transformed into cristobalite and the other anti-craze materials function mostly by increasing the cristobalite content of the

body and thereby help developing a greater compression on the glaze through the "crystalite squeeze" during cooling.

A systematic study on delayed crazing was made. In all our experiments the glaze composition was kept constant, while the body composition was altered by incorporating different mineralizers. Our conclusions may be briefly summarised as follows :—

(i) the delayed crazing is mostly due to sluggish contraction of the glaze after solidification,

(ii) higher "bisque-firing" temperature of the earthenware bodies decreases the resistance to crazing, and

(iii) ferruginous materials or minerals containing a high percentage of iron oxide and cobalt oxide in collaboration with other minerals are effective anti-craze materials and in this respect they are more efficient than talc, pyrophyllite or lime.

## 28. Industrial Relations and Air Conditioning.

P. C. GUPTA, Delhi.

Fostering of better human relations is considered a part and parcel of management functions. Supervisors are becoming aware that the approach to their day-to-day problems has to recognise the human element in addition to the technical considerations. Because all technically perfected plans can be set at naught if the people don't follow what they are expected to do. The paper reviews briefly the activities of the 'Training within Industry' scheme. It then explains the influence of the working conditions on the operative and how these conditions do mar or make the attitude of the worker by lowering down his working efficiency for giving desired production. In the end the desirability of better working conditions has been shown and hope is expressed that better environment will help better human relations.

## METALLURGY

### 29. Studies on Oxidation Resistance of Titanium at high temperatures by diffusion Anneal of Chromium.

R. GANGULI and G. P. CHATTERJEE, Sibpore.

In spite of its fairly good resistance against oxidation at ordinary temperature, titanium readily combines with oxygen at 500°C. It is one of the few elements which can also be made to burn in nitrogen. It has been found that the rate of oxidation may be minimised by coating with Chromium, but due to the diffusion of titanium ions through chromium layer, aided with the diffusion of chromium into the titanium, the oxidation resistance is not quite effective at temperatures higher than 600°C. Theory indicates that rate of oxidation over metallic surfaces may be reduced by the introduction of layers containing materials of comparatively poor ionic and/or electronic conductance. An attempt has been made in this paper to introduce a mixed layer of chromium and oxide of chromium by plating titanium with chromium and annealing it under low vacuum at 900°C. permitting chromium to diffuse and also forming a layer of oxide. It has been found that a second layer of chromium plating offers a much greater resistance to oxidation at



700°C. The difficulties of plating titanium are well known. Quantitative data on electroplating with chromium and also the rate of oxidation with and without plating are incorporated in the paper. Since titanium at the temperature of this investigation is HCP and chromium is BCC some discussions are also incorporated with particular reference to the phase  $TiCr_3$  in inhibiting diffusion.

### 30. Inhibitive Action of Chromates, Molybdates and Tungstates of Zinc and Lead on the Corrosion of Steel.

S. C. SHOME and A. K. CHAUDHURY, Calcutta.

The chromates, molybdates and tungstates of zinc and lead are used as pigments and the inhibitive behaviour of these pigments against the corrosion of steel is investigated.

The results of the experiments employing the aqueous extracts, indicate that the zinc pigments fall in the sequence : zinc molybdate, zinc chromate, zinc tungstate, zinc dust, zinc oxide ; zinc molybdate being the most inhibitive and zinc oxide the least inhibitive. The zinc chromate extract protects the steel specimens against corrosion, but it produces water-line attack. The excellent inhibitive property of zinc molybdate may be attributed to two facts : (i) the low solubility of the pigment in water, and (2) its mild oxidizing power. Zinc tungstate, which is a weaker oxidizing agent than zinc molybdate, shows lesser protective action. The lead compounds, whose solubilities in water are very low, do not exhibit any protective action against the corrosion of steel.

The study of the aqueous extracts of the oil-paints reveals that while zinc molybdate retains its protective behaviour in the paint, the zinc chromate paint has practically no inhibitive property. The zinc-tungstate paint makes water slightly non-corrosive, while the paint obtained from lead molybdate or red lead shows only feeble inhibitive action on steel. The results suggest no correlation between the anti-corrosive property of any of the pigments or paints and the alkalinity of its aqueous extract.

### 31. Underground Corrosion of Ferrous Metals.

B. CHATTERJEE, Sibpur.

Corrosivity of two soils, (i) from Maynaguri (Jalpaiguri, West Bengal), and (ii) from Sibpur (Howrah, West Bengal), for ferrous metals has been studied by measuring the weight losses on soil-corrosion cell electrodes made of wrought iron after exposure to these soils for 6 months in an atmosphere saturated with water vapour. The combined weight losses of the anode and cathode have been found to be 0.054 gm. per sq. cm. for soil I and 0.040 gm. per sq. cm. for soil II. The initial cell current was found to be 160 micro-amperes for both the soils but the effect of time on the changes of the cell current differed indicating that the rates of corrosion of wrought iron exposed to soils I and II were different.

### 32. A New Phase Structure of Molybdenum.

P. S. AGGARWAL and A. GOSWAMI, Poona.

Polymorphism is often exhibited by metals such as Ni, Co, Ag, Fe and Cu. Molybdenum, however, has so far only been observed in b.c.c. structure. It has

been found by electron diffraction that Mo evaporated in vacuum onto glass or rock-salt substrates in thin layers some times has a f.c.c. structure,  $a_0 = 4.16 \text{ \AA}$ . This value of  $a_0$  is slightly higher than the one calculated on the basis of the suggestion of Agarwala and Wilman that the  $\alpha$ - $\gamma$  phase transition of Fe generally occurs in the interface  $[110]$ ,  $\langle 111 \rangle$ , b.c.c./ $[100]$ ,  $\langle 110 \rangle$ , f.c.c. A similar, though smaller, increase in lattice parameter, has also been observed in the case of thin zirconium and thallium films.

### 33. Structure of Electro-deposited Nickel and Cathodic Crystal growth process.

B. C. BANERJEE and A. GOSWAMI, Poona.

An electron-diffraction study was made of the crystal structure, orientation and mode of growth of nickel deposits from sulphate-chloride-boric-acid and chloride-boric-acid baths under various bath conditions. The effect of pH, temperature, concentration, mechanical stirring, etc., and of additions such as sodium chloride, and oxidising agents such as hydrogen peroxide and nickel nitrate was studied on polycrystalline brass or iron substrates.

The deposits generally developed  $[210]$  orientation at low temperatures ( $\sim 10^\circ\text{C}$ ) throughout the pH range examined. At room temperature ( $\sim 25^\circ\text{C}$ ) the same orientation was continued provided the pH of the solution was low; at a higher pH the deposits developed either  $[100]$  or  $[1010]$  and  $[211]$  orientations, characteristic of lateral growth. At higher temperatures (about  $50^\circ\text{C}$  or above in the case of sulphate-chloride-boric-acid bath and  $40^\circ\text{C}$  or above in the case of chloride-boric acid bath) the crystal orientation was  $[110]$ , characteristic of outward growth. At  $75^\circ\text{C}$  and pH 5 the mixed bath produced  $[100]$  orientation, characteristic of lateral growth. The dilution of the baths favoured  $[100]$  orientation under conditions otherwise leading to  $[100]$  or  $[1010]$  and  $[211]$  orientations. Mechanical stirring of the solution generally led to lateral growth although in the absence of stirring  $[110]$  or  $[210]$  orientations would have occurred. Hydrogen peroxide in small quantities similarly changed the  $[210]$  orientation to lateral growth. The development of  $\{210\}$  orientation which is generally accompanied by a considerable evolution of gas at the cathode appears to be associated with the adsorption or otherwise of hydrogen by the deposits during the crystal growth process. Nickel nitrate favours  $[110]$  orientation, presumably due to the depletion of metal ions at the cathode surface region, caused by the formation of an ammoniated complex resulting from the cathodic reduction of nitrate. Sodium chloride tends to modify  $[100]$  orientation to  $[211]$  and  $[1010]$ .

A general mechanism of cathodic crystal growth has been suggested.

### 34. Anelastic strain and vibration damping capacities of Metals and Alloys.

G. P. CHATTERJEE, Sibpore.

Several methods are available to determine experimentally and compute the specific damping capacities of metals and alloys defined as the amount of energy dissipated per unit volume of the material per unit stress in one stress-cycle. The anelastic behaviour of metals and alloys as revealed by their non-linear stress-strain plots even under low stress-levels (much below the so-called elastic limit) appear to be directly related to their vibration damping capacities. It is often difficult however to evaluate from the conventional vibration decay curves that

part of the total strain which is responsible for damping. An attempt has been made in this paper to develop from the fundamentals a few concepts which lead to the relation.

$$\epsilon_d = \frac{TS}{\pi GA} \frac{dA}{dt} \left[ 1 + \frac{1}{2} \left\{ \frac{T}{2\pi A} \frac{dA}{dt} \right\}^2 \right]$$

where,

$\epsilon_d$  = that part of the total strain which is responsible for damping at a stress level S.

S = Stress

A = Amplitude of vibration

G = Young's modulus

T = Undamped period

t = Time

To compute the value of  $\epsilon_d$ , that is, that value of strain which is responsible for damping, one has merely to determine the negative slope  $\frac{dA}{dt}$  of an amplitude decay plot of A as function of t at different known values of A. Values of T, S and G are either known or may be easily determined.

### 35. Development of new alloy Steels with reference to elements available in India.

G. P. CHATTERJEE, B. CHATTERJEE, K. C. SOM and S. S. PANI, Sibpore.

A very large number of alloy steels with specific properties are manufactured and fabricated to day for different purposes. Many of these can be made in India provided the necessary ferro-alloys and other materials are available. Except for some grades of Ferro-silicon and ferro-manganese most of the ferro-alloys and other materials are imported from abroad. With reference to some common alloying elements in Steel it is well known that India is fairly rich in ore-minerals of some important metals like Manganese, Chromium, Titanium, Aluminium etc., but rather poor in some of the key alloying elements like Nickel, Tungsten, Molybdenum and others. Of these Nickel and Tungsten are extremely vital. It has been felt very essential therefore that an extensive research and investigatory work be started to find suitable substitutes at least for these two elements with metals like Manganese and Titanium for which there are extensive deposits in this country. With this object in view an attempt has been made in this paper to develop a stainless steel without Nickel with good resistance to oxidation at high temperature.

The properties of several steels containing 9/11 per cent carbon, 14/21% Manganese, 5/10 per cent Chromium with or without small amounts of Aluminium and Titanium have been studied. Very encouraging results have been obtained with one of these steels with fairly good deep-drawing characteristics and oxidation resistance.

### 36. Production of Ferro-Manganese in India.

R. N. AGARWAL.

India has large reserves of manganese ore, the primary raw material for manufacturing ferro-manganese. These are at present exploited mainly for export which fetches a very much smaller return (about Rs. 240/- per ton of manganese ore as against Rs. 750/- per ton ferro-manganese). Keeping in view the several advantages that would accrue from development of natural resources including much

larger export earnings, the First Five Year Plan recommended that the export of finished or at least semi-finished product should be encouraged in the case of manganese ore.

The requirements of ferro-manganese for the iron and steel industry by 1960-61 have been estimated at 60,000 tons for an output of 6 million tons of ingot steel. There is some scope for developing an export trade also in ferro-manganese, for though most of the steel producing countries manufacturing their requirements of ferro-manganese by importing raw ore, the U. S. A. which is the largest consumer, produces only 75 to 80% of her ferromanganese requirements. The balance which is of the order of 1,25,000 to 2,00,000 tons per annum is met out of imports from countries like Norway, Canada and France. The large scale expansion of steel production envisaged in several countries over the coming years will increase the consumption of ferro-manganese. From an over-all view it is considered that, provided the quality and price are satisfactory, about one lakh tons of domestic output could be absorbed by export requirements by 1960-61. This would contribute to export earnings about Rs. 8/- crores at current prices.

### 37. Studies on the Vanadium bearing Titaniferous Magnetite.

R. K. MITRA and G. P. CHATTERJEE, Sibpore.

Earlier reports of investigation by the authors on the vanadium bearing titaniferous magnetite revealed that due to unfavourable mode of occurrences of titanium bearing constituents and vanadium in the ore mineral, the problem of utilising or isolating the titanium and the vanadium is not only that of ore-dressing but one melting also. In as much as titanium occurs both as  $TiO_2$  and  $FeO$ ,  $TiO_2$  and vanadium presumably as  $FeO$ .  $V_2O_5$  (Spinel) it was thought that such occurrences may be taken advantage of by converting the mineral to a sintered product of the type of Cermets and the line of work was directed accordingly. To impart a tough and ductile matrix to the refractory oxides two methods were adopted namely, (1) Pre-reduction of the ore by coal gas at  $1050^\circ C$  for three hours followed by vacuum sintering at temperatures 1050, 1100 and  $1150^\circ C$  (2) Sintering in an atmosphere of dry Hydrogen at the said temperatures. In all cases the materials were used in the form of pellets. In order to obtain a high degree of reduction certain energizers were tried with very encouraging results.  $Na_2CO_3$  and  $K_2CO_3$  or a mixer of the two in equal proportion were found most effective. At  $1150^\circ C$  using 10% by weight of  $Na_2CO_3$  as energizer a very hard coherent and compact pellet was obtained.

### 38. Preparation of High-Ti Aluminium-titanium alloy by direct reduction of $TiO_2$ by Aluminium.

P. K. SEN, B. CHATTERJEE and G. P. CHATTERJEE, Sibpore.

Titanium Dioxide can be reduced by Aluminium according to the Aluminothermic reaction



An attempt has been made in this paper to prepare an Alloy containing more than 15% Ti.

A synthetic mixture of Sodium Fluoride ( $NaF$ ) and Aluminium Fluoride ( $AlF_3$ ) in suitable proportion was melted in a graphite crucible and maintained at a high temperature. Known amounts of  $TiO_2$  was fed in the Molten Slag. Molten Alu-

minium superheated to 900°C was added slowly in the graphite crucible. A vigorous reaction followed. The Alloy when taken out after casting was analysed to contain 17% Ti.

Some precautions and other features of the process have been incorporated in the paper.

### **39. Investigations on Colorimetric Methods of Metallurgical Analysis.**

G. V. L. N. MURTY, Jamshedpur.

A simple procedure has been described for the estimation of silicon in pig iron which compares very favourably in regard to the accuracy attainable with the standard gravimetric method. This new procedure has the striking advantages of reducing the speed of analysis to 15 minutes, a factor which is of considerable importance in steel works analysis.

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25th	"	1938,	Calcutta	...	...	...	...	30	0	0
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27th	"	1940,	Madras	...	...	...	...	27	6	0
28th	"	1941,	Banaras	...	...	...	...	30	4	0
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38th	"	1951,	Bangalore	...	...	...	...	27	12	0
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